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PROPERTY OF DEPT. C-270
METROLOGY LAB.
DO NOT REMOVE
FROM AREA

D-150A

DUAL-CHANNEL
POWER AMPLIFIER

20049

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INSTRUCTION MANUAL

Serial No. . . .
Issued . . . . . .

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METROLOGY LAB.
DO NOT REMOVE
FROM AREA

D-150A
DUAL-CHANNEL POWER AMPLIFIER

CROWN INTERNATIONAL INC. BOX 1000 ELKHART, INDIANA 46514

crown

packing list

PLEASE CHECK THIS PACKING LIST TO ASSURE THAT ALL ACCESSORIES ARE INCLUDED WITH YOUR CROWN PRODUCT. IF ANY ITEMS LISTED ARE MISSING OR INCORRECT, PLEASE COMPLETE AND MAIL THE ENCLOSED "INCOMPLETE ACCESSORY NOTIFICATION" CARD.

2 PIN TO PHONE CABLES
4 THUMB SCREWS & WASHERS
1 SET 5" RACK EARS
1 ALLEN WRENCH
1 D-150A OWNERS MANUAL
1 PROOF OF PERFORMANCE SHEET
1 HI FI ADAPTER KIT:
- 2 DUAL BANANA PLUGS
- 2 FUSES & FUSEHOLDERS
- 2 WIRE NUTS

D150A AMPLIFIER

FULL THREE-YEAR WARRANTY

THE WARRANTY

For a period of three years from the date of delivery to the original Purchaser, Crown International, Inc. (hereinafter "Crown") warrants to the original and any subsequent purchaser of each new Crown component (except Crown recorders) that it is free from any substantial defects in materials or workmanship and that it will meet or exceed all advertised specifications for such component.

NOTIFICATION OF CLAIMS

The Purchaser must notify Crown in writing at the address set forth below of any claimed breach of warranty. Such notification shall be delivered to Crown within a reasonable length of time after the discovery of the claimed defect and not later than ninety days after expiration of the warranty period. Within ten business days after receipt of the notification, Crown will request Purchaser to deliver the component to an authorized service agency for repairs or will deliver to Purchaser written authorization to return the component to Crown for factory warranty service. If Crown's (or its authorized service agency's) inspection reveals that there has been a breach of the warranty, Crown (or its authorized service dealer) will initiate corrective repairs within thirty days after receipt of the component. All components must be shipped in original factory pack, which if needed, may be obtained from Crown free of charge.. All such repairs, including labor, parts and shipping costs within the United States will be made at Crown's expense. Purchaser must bear the expense of shipping the component between any foreign country and the part of entry in the United States, and all taxes, duties and other custom's for such foreign shipments.

WARRANTY

If the repairs made by Crown or the authorized service dealer are not satisfactory, Purchaser should immediately give written notification to Crown. If the defect or malfunction remains after a reasonable number of attempts by Crown to remedy the defect or malfunction, the Purchaser shall then have the option to elect either a refund for or replacement without charge of, the Crown component. The refund shall be an amount equal to the actual purchase price, not including any interest, insurance, closing costs and other finance charge, minus reasonable depreciation on the component. If a refund is demanded, the Purchaser must make the defective or malfunctioning component available to Crown free and clear of all liens or other encumbrances. Should Crown fail to meet its obligation hereunder, Purchaser may sue Crown to secure its compliance with this warranty. ANY SUIT BY PURCHASER FOR BREACH OF THIS WARRANTY MUST BE FILED WITHIN FOUR (4) YEARS OF THE DATE OF DELIVERY TO THE ORIGINAL PURCHASER.

WARRANTY VIOLATIONS

CROWN SHALL HAVE NO RESPONSIBILITY IF THE COMPONENT HAS BEEN SUBJECT TO MISUSE, ACCIDENT, NEGLECT OR FAILURE TO COMPLY WITH NORMAL MAINTENANCE PROCEDURES OR IF THE SERIAL NUMBER HAS BEEN DEFACED, ALTERED OR REMOVED; NOR WILL CROWN ACCEPT RESPONSIBILITY FOR OR RESULTING FROM IMPROPER ALTERATIONS OR UNAUTHORIZED PARTS OR REPAIRS. THIS WARRANTY DOES NOT COVER ANY DAMAGE TO SPEAKERS OR ANY OTHER CONSEQUENTIAL DAMAGES RESULTING FROM BREACH OF ANY WRITTEN OR IMPLIED WARRANTY.

MODIFICATIONS OF EQUIPMENT

Crown reserves the right to modify or change equipment in whole or part at any time prior to delivery therof, in order to include therein electrical or mechanical improvements deemed appropriate by Crown, but without incurring any liability to modify or change any equipment previously delivered, or to supply new equipment in accordance with any earlier specification.

WARRANTY ALTERATIONS

NO PERSON HAS THE AUTHORITY TO ENLARGE, AMEND OR MODIFY THIS WARRANTY. THE WARRANTY IS NOT EXTENDED BY THE LENGTH OF TIME WHICH THE PURCHASER IS DEPRIVED OF THE USE OF THE COMPONENT. REPAIRS AND REPLACEMENT PARTS PROVIDED PURSUANT TO THIS WARRANTY SHALL CARRY ONLY THE UNEXPIRED PORTION OF THIS WARRANTY.

CROWN INTERNATIONAL, INC.
1718 West Mishawaka Road, Elkhart, Indiana 46514

OWNER_____

ADDRESS_____

THIS STATEMENT OF WARRANTY SUPERSEDES ALL OTHERS CONTAINED IN THIS MANUAL

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Front panel controls of the D-150A include two independent level controls and a power switch with an associated pilot light. Two IOC "Input-Output Comparator" red LED's continuously monitor program material, and will indicate when the distortion specifications of the amplifier are being exceeded due to output non-linearity. These LED's (one per channel) are located above each input level control.

The IOC indicators will normally remain off, except for a short time about a minute after turn-off of the AC power to the amplifier. Lighting of the LED's during operation means:

A) Clipping - reduce input level settings.

B) Protection-Circuit Activation - check output lines for shorts or loads under 2.5 ohms. (see section 2.4).

C) Slew-Induced Distortion - check for ground loops or RFI at input(s).

The IOC overload detector is a simple window comparator using two op-amps and a LED indicator. The IOC is highly sensitive and detects distortion that is a great deal less than the .05% ratings of the D-150A, and is calibrated to light when the specifications are being approached or exceeded.

A very small non-linearity in the output stages causes an error signal in the feedback loop to apppear at the input to the main op-amp. This causes the op-amp output to rise above its normal value, exceeding the "window" of the IOC and lighting the LED. Since transient overload can happen very quickly, a pulse-stretching circuit is added so the human eye can detect the LED lighting.

IOC
IOC
crown
D150A

DESCRIPTION

1.1 GENERAL

FIGURE 1-1
INTEGRATED CIRCUIT STEREO
D-150A AMPLIFIER
(Shown with optional walnut cabinet)

The D-150A is a dual-channel medium power amplifier for ultra-low distortion amplification from DC to 20KHz with operation into loads of 4 ohms and higher. The unit features extremely low harmonic and intermodulation distortion, very low noise, highest "damping factor," and quality parts and workmanship. The unit may be wired to produce a balanced 50 volt monaural output. The D-150A contains a new CROWN-developed **S**ignal **P**rogrammed **A**utomatic **C**urrent **E**xecutor (SPACE control) electronic amplifier protection circuit which manifests no flyback pulses, thumps, or shut-down. At audio frequencies any impedance load including totally reactive loads may be driven with no adverse effects. Only maximum output power will be affected by variations in load impedance. At sub-sonic to DC frequencies the limiter acts as a VI limiter to provide optimum protection for the extremely rugged silicon output devices. A thermal switch removes power from the unit if overheating occurs due to insufficient ventilation.

The power supply features large computer-grade filter capacitors giving over 20 joules of energy storage.

A total of 32 discrete transistors, 1 linear IC (dual op amp), 21 diodes and 1 bridge rectifier are utilized in a CROWN-pioneered Class AB+B output circuit. The effective number of semiconductors is 48 transistors and 31 diodes.

The input voltage-amplifiers, (IC), are powered by two voltage-regulated supplies. This results in complete channel-to-channel isolation and independence from line voltage variations.

Front panel controls include two independent level controls and a power switch with an associated pilot light.

Total direct coupling results in perfect, instantaneous, thump-free overload recovery even on non-symmetrical waveforms. This cannot be said for any AC-coupled amplifier presently in existence. Turn-on is instantaneous with minimum thump and no program delay.

1.2 SPECIFICATIONS

1.2.1 STEREO SPECIFICATIONS

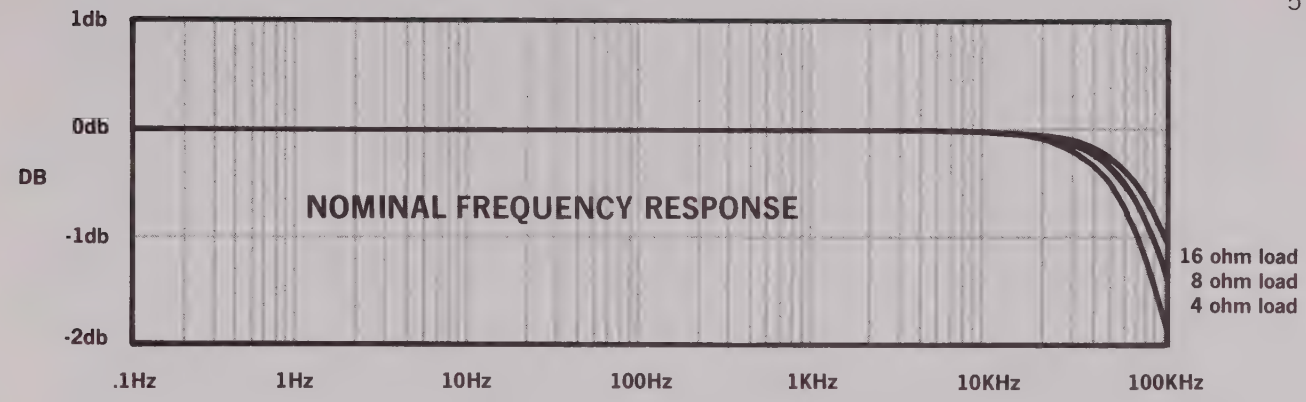
Output Power	**80 watts per channel minimum RMS (both channels operating) into an 8 ohm load over a bandwidth of 1Hz-20KHz at a rated RMS sum total harmonic distortion of 0.05% of the fundamental output voltage.**
Frequency Response	±0.1dB DC-20KHz at 1 watt into 8 ohms; ±1dB DC-100KHz.
1KHz Power	90 watts RMS into 8 ohms, per channel, both channels operating, 0.1% total harmonic distortion.
Harmonic Distortion	Less than 0.001% from 20Hz-400Hz, and increasing linearly to 0.05% at 20KHz at 80 watts RMS per channel into 8 ohms.
I.M. Distortion (60Hz-7KHz 4:1)	Less than 0.05% from 0.01 watt to 0.25 watts and less than 0.01% from 0.25 watts to 80 watts into 8 ohms, per channel.
Slewing Rate	6 volts per microsecond (slewing rate is the maximum value of the first derivative of the output signal, or the maximum slope of the output signal).
Damping Factor	Greater than 400, DC-400Hz into 8 ohms.
Output Impedance	Less than 15 milliohms in series with less than 3 microhenries.
Load Impedance	Rated for 8 ohm usage; safely drives any load including completely reactive loads.
Voltage Gain	20.6±2% or 26.3±.2dB at maximum gain.
Input Sensitivity	1.19 volts ±2% for 80 watts into 8 ohms.
Output Signal	Unbalanced, dual channel.

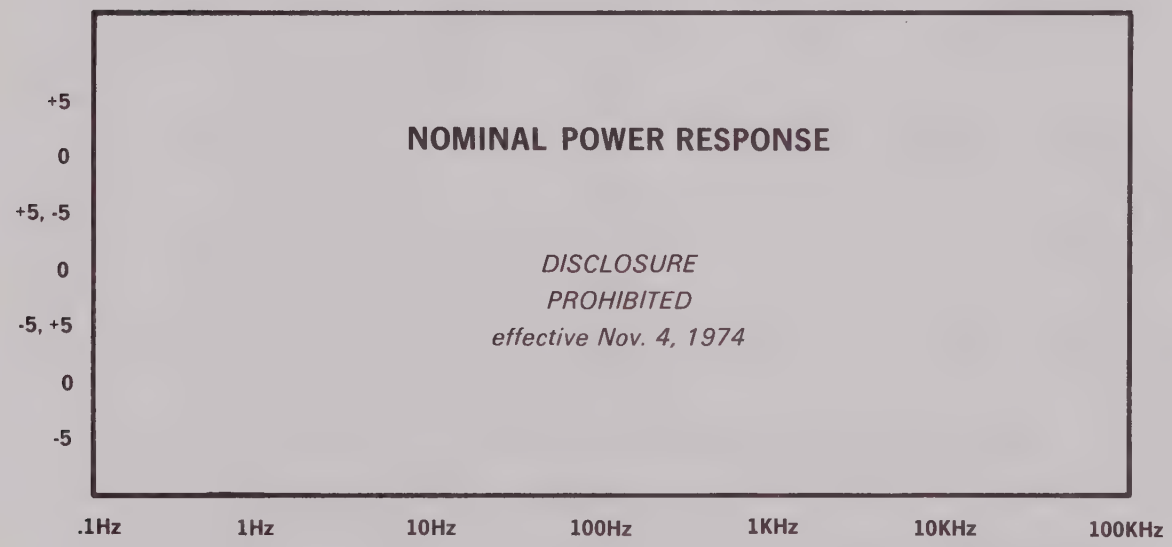
1.2.2 MONAURAL SPECIFICATIONS

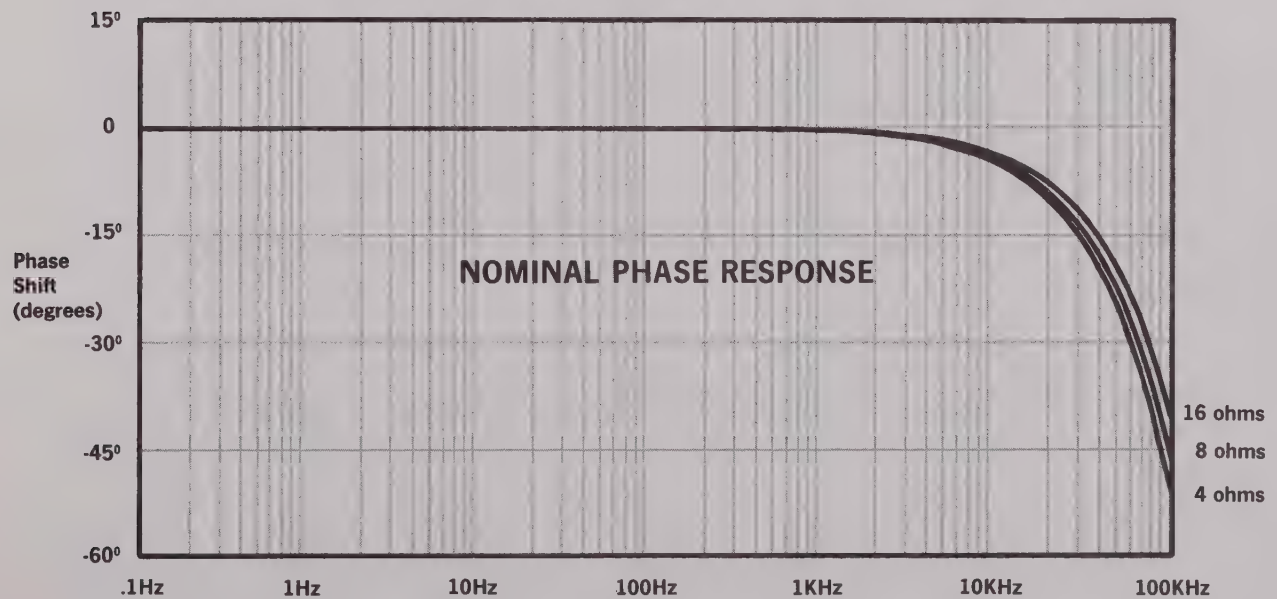
Output Power	**160 watts minimum RMS into a 16 ohm load over a bandwidth of 1Hz-20KHz at a rated RMS sum total harmonic distortion of 0.05% of the fundamental output voltage.**
Frequency Response	±0.15dB DC-20KHz at 1 watt into 16 ohms; ±1dB DC-60KHz.
1KHz Power	180 watts RMS into 16 ohms.
Harmonic Distortion	Less than 0.001% from 20-400Hz and increasing linearly to 0.05% at 20KHz at 160 watts into 16 ohms.
I.M. Distortion S.M.P.T.E. 60Hz and 7KHz	Less than 0.05% from 0.01 watts to 0.25 watts and less than 0.01% from 0.25 watts to 160 watts into 16 ohms, per channel.
Slewing Rate	12 volts per microsecond.
Damping Factor	Greater than 400, DC-400Hz into 16 ohms.
Output Impedance	Less than 30 milliohms in series with less than 6 microhenries.
Load Impedance	Rated for 16 ohm usage; safely drives any load including completely reactive loads.
Voltage Gain	41.2±2% or 32.3±0.2dB at maximum gain.
Input Sensitivity	1.19 volt ±2% for 160 watts into 16 ohms.
Output Signal	Balanced, single channel.

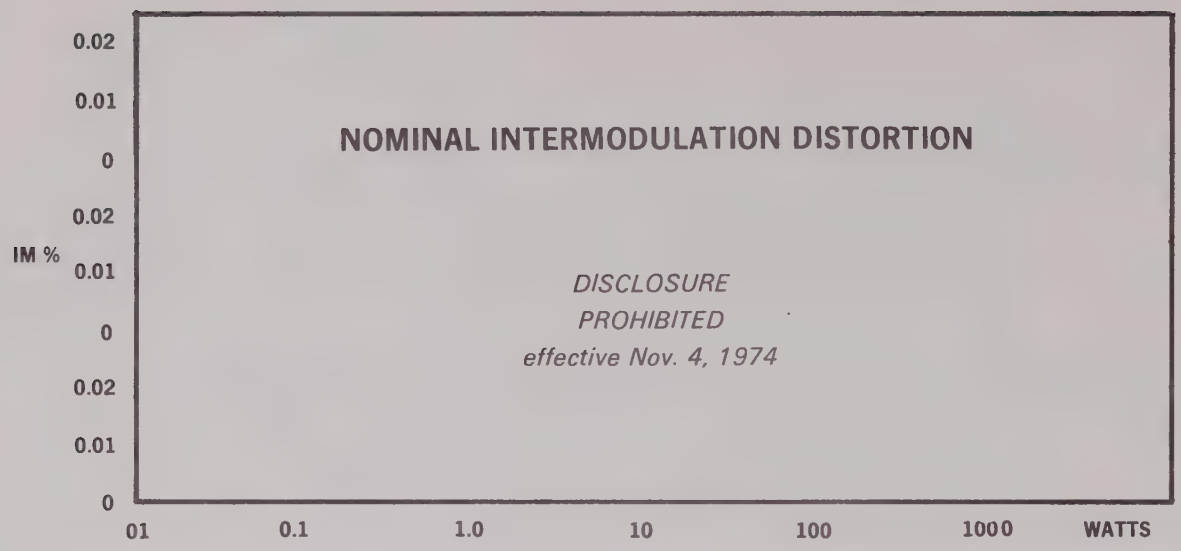
1.2.3 GENERAL SPECIFICATIONS

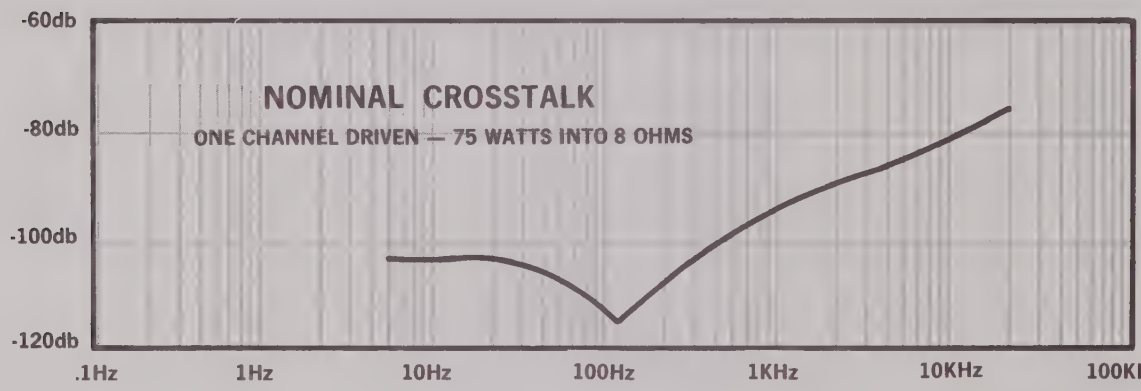
Hum and Noise (20Hz-20KHz)	110dB below rated output.
Phase Respose	+0, -15°, DC-20KHz at 1 watt.
Input Impedance	25K ohms, ±30%.
Amplifier Output Protection	Short, mismatch, and open circuit proof. Limiting is instantaneous with no flyback pulses, thumps, cutout, etc. No premature limiting on transients.
Overall Protection	AC line fused. Thermal switch in AC line protects against overheating caused by insufficient ventilation. Controlled slewing-rate voltage amplifiers protect overall amplifier against RF burnouts. Input overload protection is furnished by internal resistance of inputs of amp.
DC Output Offset (Shorted Input)	10 millivolts or less, internally adjustable to zero.
Turn-On	Instantaneous, with minimum thumps and no program delay.
Circuit	Wideband multiple feedback loop design utilizing one linear IC (dual op-amp), total equivalent of 48 transistors, 22 signal diodes, 3 zener diodes, and 6 rectifier diodes.
Power Supply	Massive computer-grade filter capacitors store over 20 joules of energy. Two regulated supplies for complete isolation and stability.
Power Requirements	Requires 50-400Hz AC on 100, 120, 200, 220, or 240V ±10% operation. Draws 30 watts or less on idle, 250 watts at 160 watts total output.
Heat Sinking	The entire amplifier is used as a heat sink. 3/16 inch thick chassis acts as a heat sink along with auxiliary fins.
Chassis	All aluminum construction for maximum heat conduction and minimum weight.
Controls	Independent level controls are mounted on the front panel. Power switch with associated pilot light is on front panel. Non-interacting DC balance controls are mounted on main PC board under electronics cover. A mono-stereo switch is located next to the input jacks on the rear panel.
Connectors	Input — ¼ inch phone jacks. Output — color coded binding posts. AC line — 3-wire (grounded) male connector on 5 foot minimum cable.
Dimensions	17 inches long, 5¼ inches high, 8¾ inches deep (from mounting surface of front panel), 19 inches long with standard rack mounting brackets installed.
Weight	24 pounds.
Finish	Satinized aluminum front panel with gray suede Lexan insert.

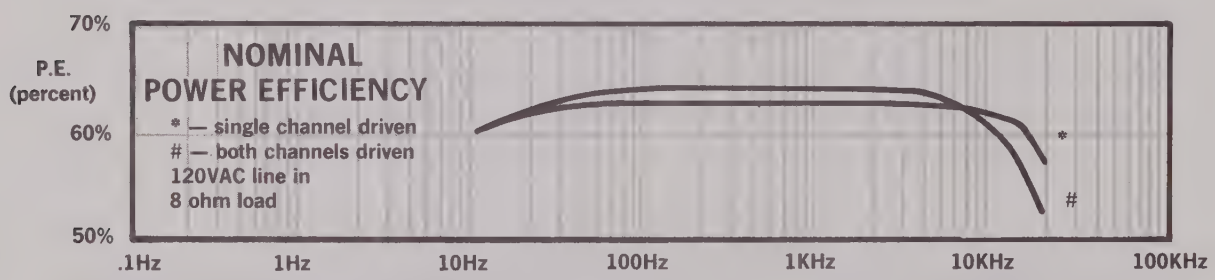

1db
0db
DB
-1db
-2db
NOMINAL FREQUENCY RESPONSE
16 ohm load
8 ohm load
4 ohm load
.1Hz
1Hz
10Hz
100Hz
1KHz
10KHz
100KHz

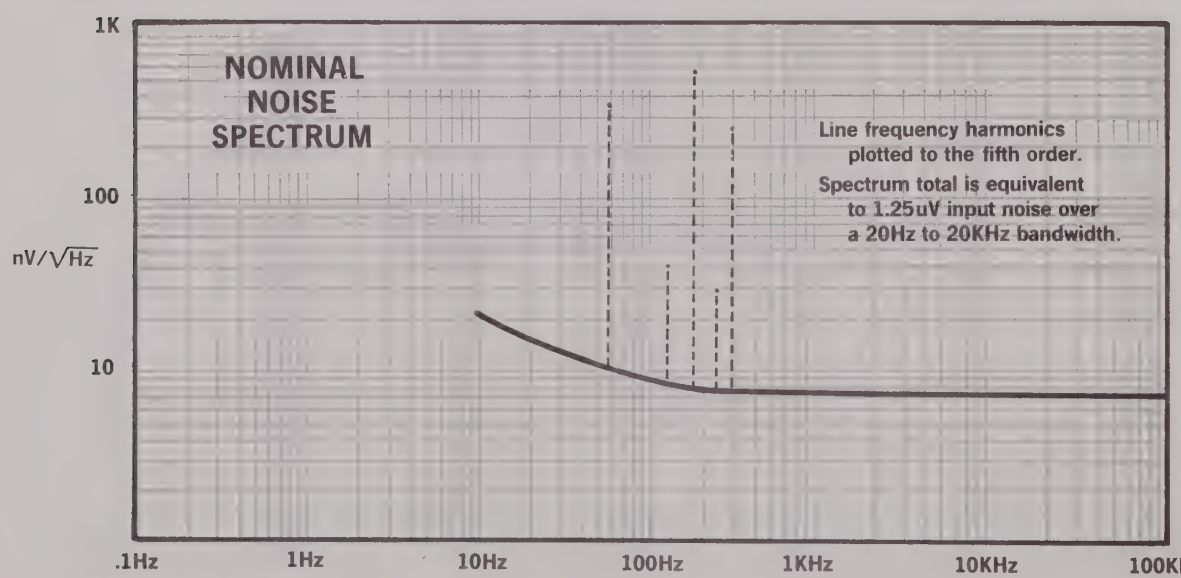

+5
0
+5, -5
0
-5, +5
0
-5
NOMINAL POWER RESPONSE
DISCLOSURE
PROHIBITED
effective Nov. 4, 1974
.1Hz
1Hz
10Hz
100Hz
1KHz
10KHz
100KHz

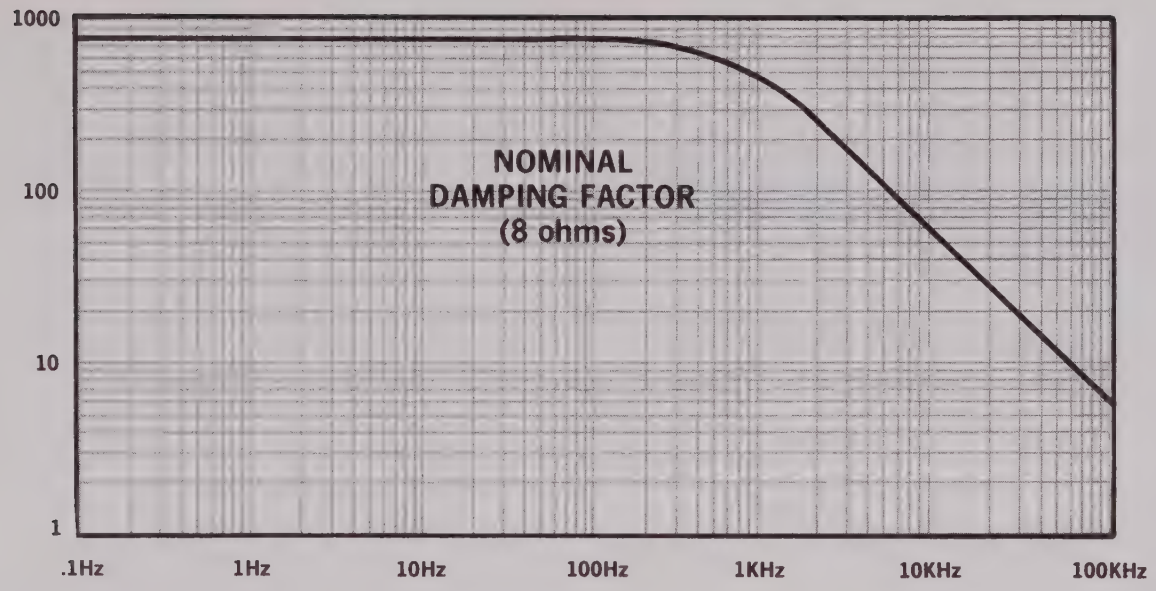

15°
0
-15°
Phase
Shift
(degrees)
-30°
-45°
-60°
NOMINAL PHASE RESPONSE
16 ohms
8 ohms
4 ohms
.1Hz
1Hz
10Hz
100Hz
1KHz
10KHz
100KHz

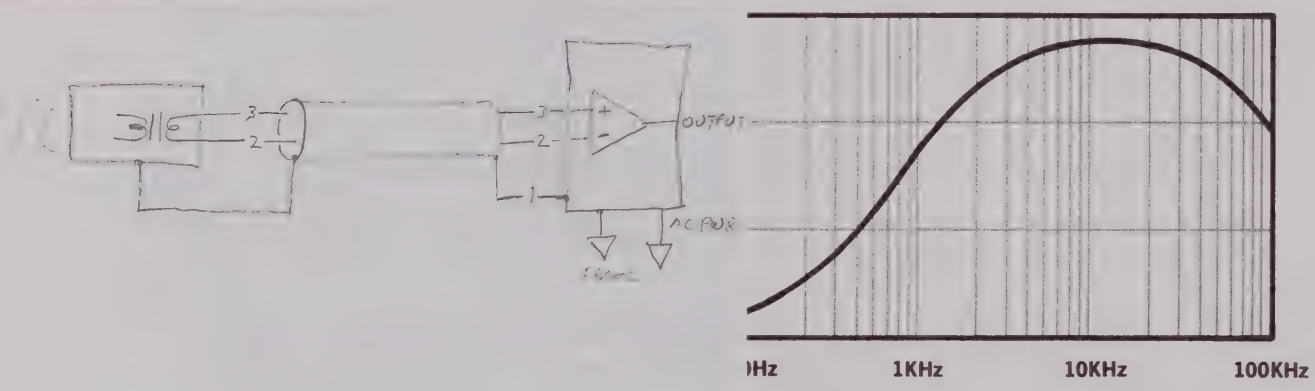

NOMINAL INTERMODULATION DISTORTION
DISCLOSURE
PROHIBITED
effective Nov. 4, 1974
IM %
0.02
0.01
0
0.02
0.01
0
0.02
0.01
0
01
0.1
1.0
10
100
1000
WATTS

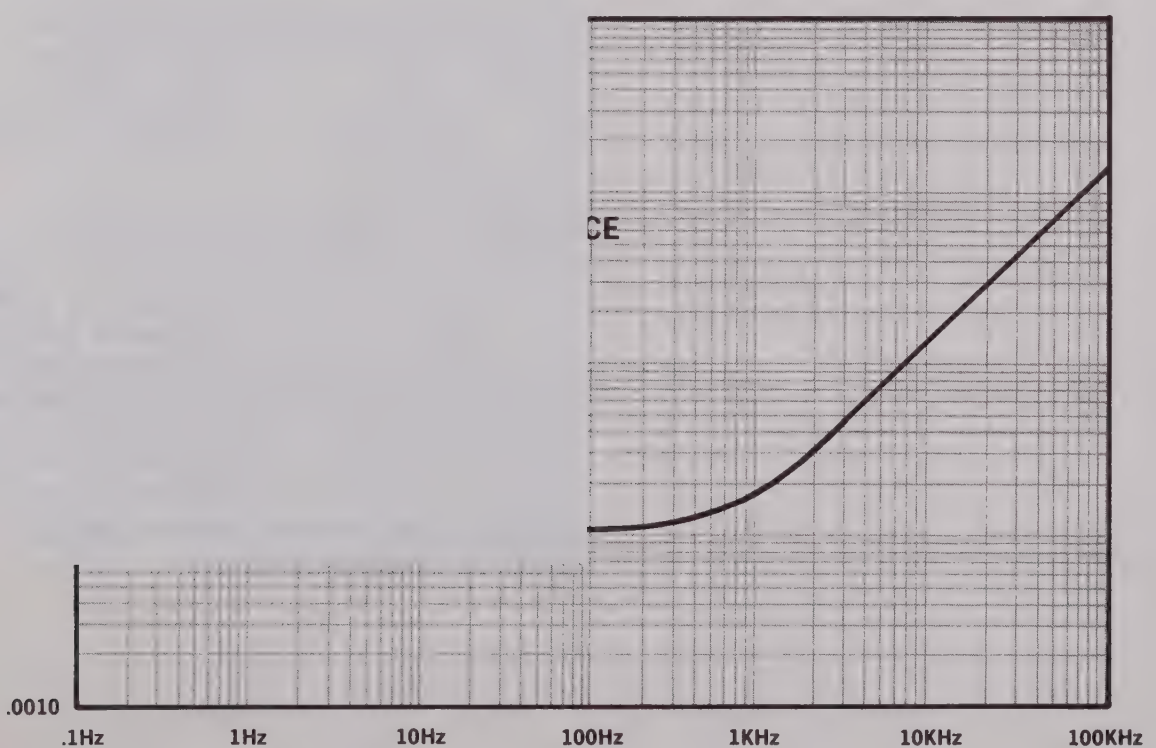

NOMINAL CROSSTALK
ONE CHANNEL DRIVEN — 75 WATTS INTO 8 OHMS
-60db
-80db
-100db
-120db
.1Hz
1Hz
10Hz
100Hz
1KHz
10KHz
100KHz

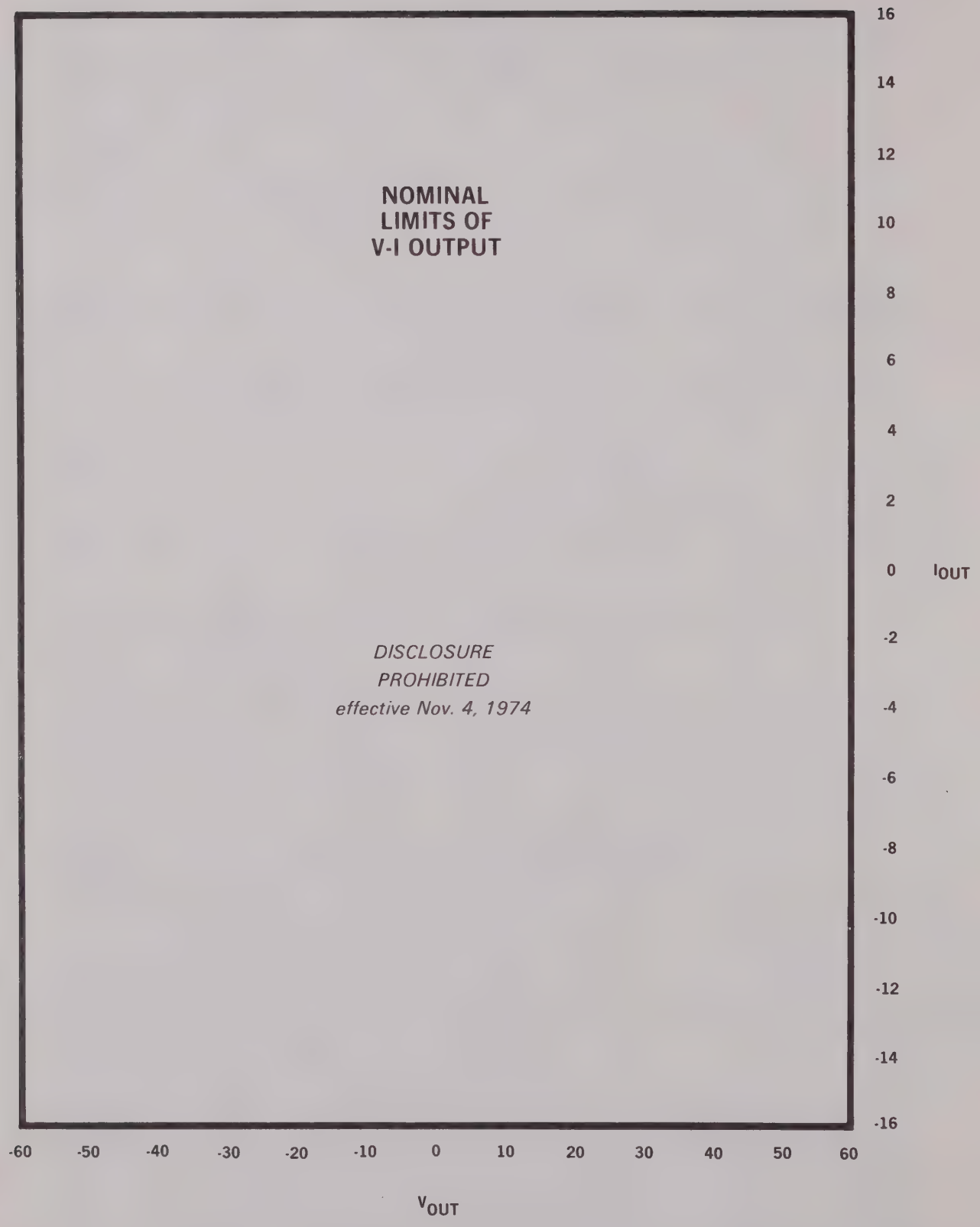

NOMINAL
POWER EFFICIENCY
* — single channel driven
# — both channels driven
120VAC line in
8 ohm load
P.E.
(percent)
70%
60%
50%
*
#
.1Hz
1Hz
10Hz
100Hz
1KHz
10KHz
100KHz


NOMINAL
NOISE
SPECTRUM
Line frequency harmonics
plotted to the fifth order.
Spectrum total is equivalent
to 1.25uV input noise over
a 20Hz to 20KHz bandwidth.
1K
100
10
nV/√Hz
.1Hz
1Hz
10Hz
100Hz
1KHz
10KHz
100KHz


1000
100
10
1
NOMINAL
DAMPING FACTOR
(8 ohms)
.1Hz
1Hz
10Hz
100Hz
1KHz
10KHz
100KHz


OUTPUT
1KHz
10KHz
100KHz


.0010
.1Hz
1Hz
10Hz
100Hz
1KHz
10KHz
100KHz


NOMINAL
LIMITS OF
V-I OUTPUT
DISCLOSURE
PROHIBITED
effective Nov. 4, 1974
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
IOUT
-60
-50
-40
-30
-20
-10
0
10
20
30
40
50
60
VOUT

1.3 WARRANTY

CROWN guarantees this equipment to perform as specified. CROWN also warrants the components and workmanship of this equipment to be free from defects for a period of 3 years from date of purchase.

This warranty does not extend to fuses, and/or component or equipment damage due to negligence, misuse, shipping damage or accident; or if the serial number has been defaced, altered or removed.

A copy of the FULL THREE-YEAR WARRANTY is included with this manual. The WARRANTY is subject to the conditions contained therein. Upon receipt of the registration form, CROWN will issue a WARRANTY TITLE. This title applies to the original end-purchaser as well as subsequent purchasers.

You, the purchaser(s), are responsible for accurate, complete records (sales slips, invoices, etc.) for FULL coverage!

1.4 ACCESSORY EQUIPMENT

1.4.1 Model 5-R Walnut Enclosure

Rich oil-walnut veneers, highlighted with flat black trim, accent the D-150A when installed on a shelf or table in a 5-R enclosure. The design of the 5-R enclosure permits vertical stacking of several components. In addition, several larger cabinet sizes are available, which accommodate multiple components in one enclosure. Available sizes are 10-R and 14-R.

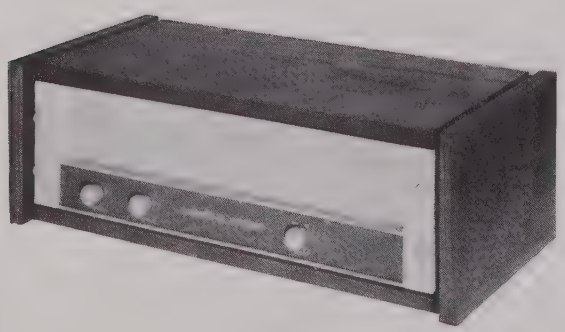


FIGURE 1-2

1.4.2 VFX-2A

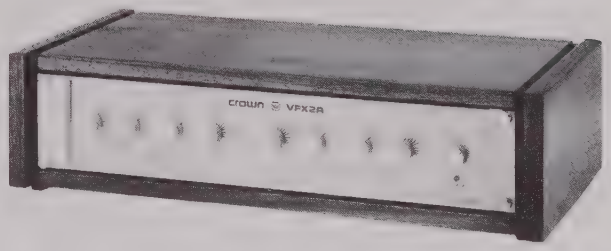


FIGURE 1-3

The CROWN VFX-2A is a dual-channel variable electronic filter-crossover. When used with a power amplifier it can greatly add to the total system capability. In combination with the D-150A, the VFX-2A adds several convenient useful functions.

The connections are made with the VFX-2A quickly and easily. If a balanced line is to be used with the unbalanced input of the D-150A the VFX-2A can serve as the interface. While maintaining these functions the output can be shaped by selecting variable high-pass, lo-pass, or band-pass filters. As a filter, the VFX-2A can be used as a crossover or ahead of several amplifiers in a bi- or tri-amped system.

Overall noise and distortion are extremely low, with IM distortion less than .01% at rated output (2.5V into 600 ohms), and noise more than 100 dB below rated output with 0 dB gain.

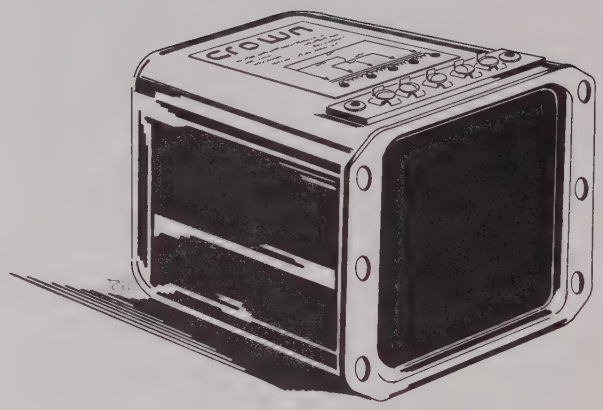
For further information please request the VFX-2A specification sheet or for a nominal fee, purchase a VFX-2A instruction manual.

1.4.3 UMX-300 TRANSFORMER

The CROWN UMX-300 transformer offers a maximum 300 watts of power with IM distortion of less than .015%. Frequency response for the unit is rated +0, -1dB, 20Hz to 20KHz at 300 watts.

Connections are made through a five-screw input-output terminal strip mounted on the front. Three holes in the flanges on each side of the casing allow convenient mounting of the unit. The UMX-300 weighs 23 lbs. and measures 6" high x 4.75" wide x 5.25" deep.

The auto-transformer configuration can convert any input of 25, 35, 50, or 70 volts to an output of 25, 35, 50, or 70 volts at any power level up to 300 watts.



INSTALLATION

2.1 UNPACKING

As soon as the amplifier shipment is received, please inspect for any damage incurred in transit. Since the unit was carefully inspected and tested at the factory, it left the factory unmarred. If damage is found, notify the transportation company immediately. Only the consignee may institute a claim with the carrier for damage during shipment. However, CROWN will cooperate fully in such an event. Be sure to save the carton as evidence of damage for the shipper's inspection.

Even if the unit arrived in perfect condition — as most do — it is advantageous to save the packing materials. They will prove valuable in preventing damage should there ever be occasion to transport or ship the unit. Note the carton and internal pack — each is designed for protection during transit. Do not ship the unit without this factory pack (or equivalent)!

For those interested in hearing the D-150A as soon as possible, please follow this fast procedure on next page.

2.2 MOUNTING

The D-150A is shipped with end bars installed. These end-bars are used for custom panel mounting.

In such a "custom installation," install a solid shelf to support the amp. It should be flush with the bottom edge of the required 16-9/16" wide x 5-1/16" high panel-cutout. The shelf should not interfere with the vertical flow of air across the heatsink fins.

Angle brackets are used for rack mounting and for installation into the 5-R or other larger CROWN "rack" cabinets.

Align the angle brackets (or end-bars) to the unit so holes "A" and "B" match the brackets or end-bars. Use 6/32 x 1/2" socket cap screws (Note: Socket screws may look as though they are crossthreading but will straighten approximately halfway through). See figure 2-1.

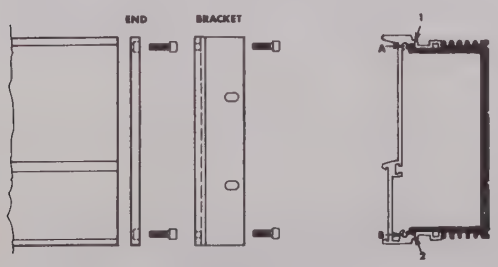


FIGURE 2-1
END-BAR/BRACKET MOUNTING

Sufficient ventilation must be provided for the unit. This means that air must be allowed to circulate over the chassis; if not, the unit will intermittently turn off due to the built-in thermal protection. Applications — other than "Hi-Fi" — requiring long, sustained signals at high power-levels may require the use of a cooling fan. When rack mounting, it is a good practice to allow a 1¾" space above and below the unit. (See figure 2-2 for mounting dimensions.)

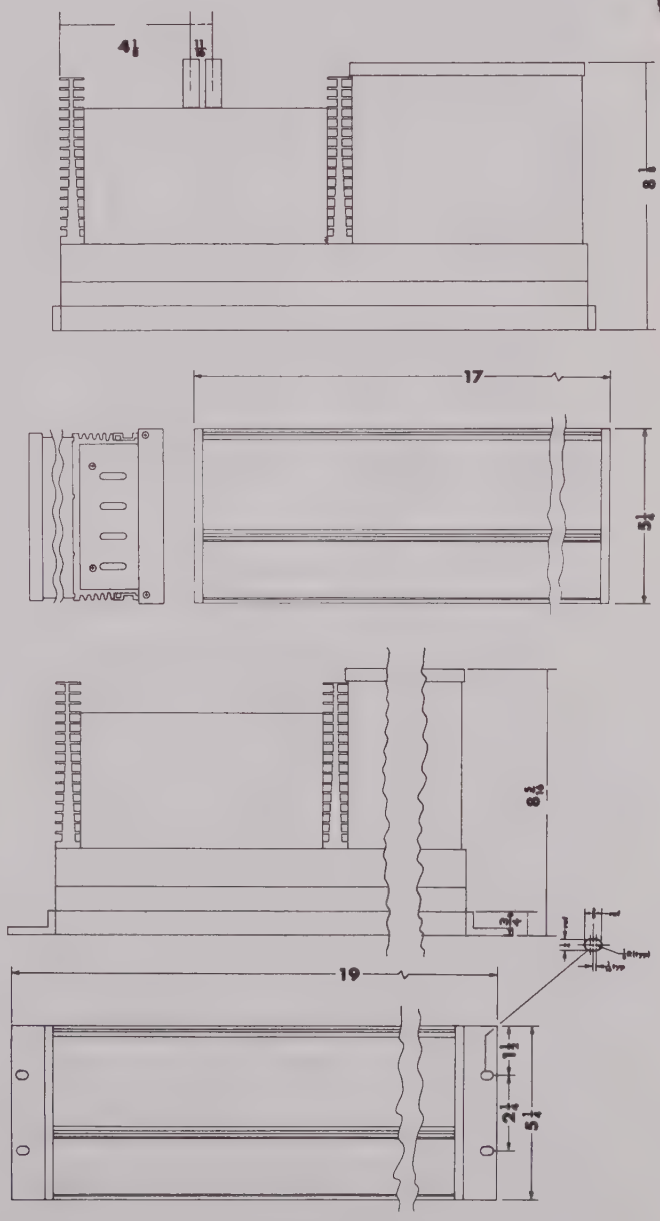


FIGURE 2-2
D-150A MOUNTING DIMENSIONS

POWER AMPLIFIER PROTECTION SYSTEMS PROTECT AMPLIFIERS, BUT NOT SPEAKERS!

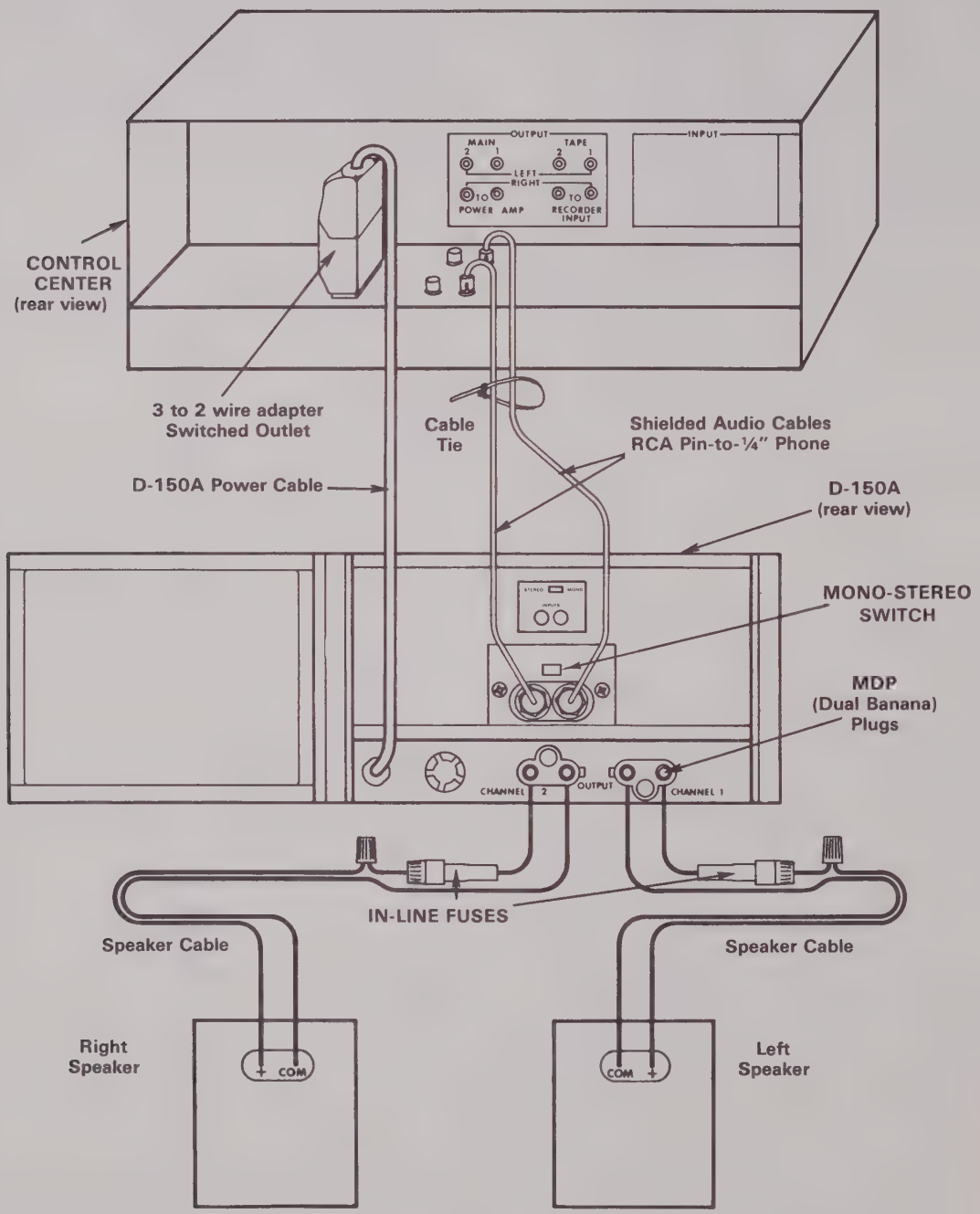


FIGURE 2-3
TYPICAL HI-FI INSTALLATION

YOU, AND/OR YOUR SPEAKER MANUFACTURER ARE RESPONSIBLE FOR SPEAKER PROTECTION!

2.3 NORMAL HI-FI INSTALLATION

1. Two conductor speaker cables must connect to the **OUTPUT** dual binding posts using terminal lugs, tinned ends, or the special "banana" plugs supplied with the D-150A. Connect the in-line fuses as recommended in the Accessory Bag and Figure 2-3!

2. Since the D-150A is a "basic amplifier," the main outputs of the control-center or "preamplifier" must be connected via shielded audio-cables to the two jacks marked **INPUT**. Use RCA-pin at pre-amp and standard ¼ in. phone-plug at the D-150A.

   The two cables should be tied parallel along their entire length using the accessory cable ties.

3. U/L requirements prefer a 3-wire AC power connector; however, proper connections to a switched outlet on the control center requires the use of a 3-to-2 wire adapter. **NOW**, plug the AC into a **switched** outlet on the control center.

4. Your Control Center may now be turned on. Then advance the D-150A Input-Gain Controls about ½-open (150° clockwise).

When using the CROWN IC-150A Control-Center, the **VOLUME** should attain almost full rotation (2 to 4 o'clock) for loudest "concert-hall" volume. If at 3 o'clock the volume is low, increase the D-150A input gain controls; if too high, decrease the D-150A gains.

To assure maximum enjoyment and full speaker protection, read the following detailed sections on **OUTPUTS, INPUTS** and Chapter 3 — **OPERATION.**

2.4 CONNECTING OUTPUT LINES

Input and output connectors are located on the chassis as shown in Figure 2-4.

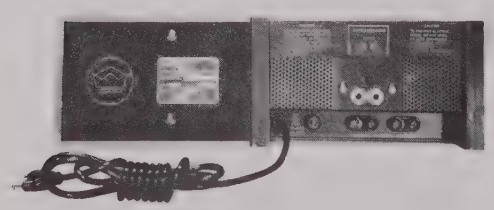


FIGURE 2-4
REAR VIEW OF CHASSIS

It is always wise to remove power from the unit and turn the input level controls off while making connections, especially if the load is a loudspeaker system. This will eliminate any chance of loud blasts. CROWN is not liable for damage incurred at any transducer to its being overpowered! The use of the enclosed speaker fuses is therefore highly recommended.

Before making connections, it is recommended that the operator familiarize himself with the amplifier's protective system. See Section 3.2. Section 3.3 entitled "Operating Precautions" should also be read.

Because of the locations of the output connectors (color-coded binding posts) it will be easiest to make these connections first. High-quality, dual "banana" plugs are the preferred connections for permanent installations.

Because the output wire gauge and length raises the resultant source impedance or lowers the Damping Factor by adding series resistance, the nomograph (Figure 2-6) is provided for wire selection. For dynamic moving-coil loudspeakers the value R_L should preferably be that measured by an ohmmeter across the voice coil, rather than the manufacturer's rating. For electrostatic speakers and such, the manufacturer's rated impedance should be used for R_L.

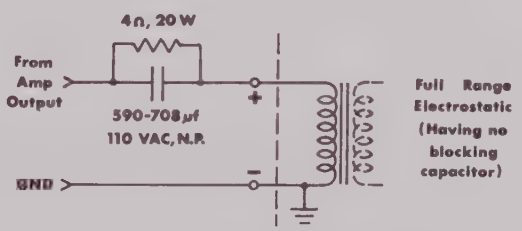


FIGURE 2-5
SCHEMATIC FOR FULL RANGE ELECTROSTATIC SPEAKER CONNECTION

If the load (matching transformer, inductance, or full-range electrostatic speaker system) appears as a short-circuit at low frequencies, a large non-polarized capacitor (paralleled with a resistor) should be placed in series with the load.

For electrostatic speakers (if the manufacturer has not provided a capacitor) an external non-polar capacitor of 590-708 mfd and 4 ohm power resistor should be placed in series with the plus (+) speaker lead. This will prevent large low-frequency currents from damaging the electrostatic transformer or from unnecessarily activating the D-150A's protective system. An effective test to determine if such parts are needed is to measure the DC resistance between the output terminals with an ohmmeter. If the resistance is less than 3 ohms, the parts should be added as shown schematically in Figure 2-5.

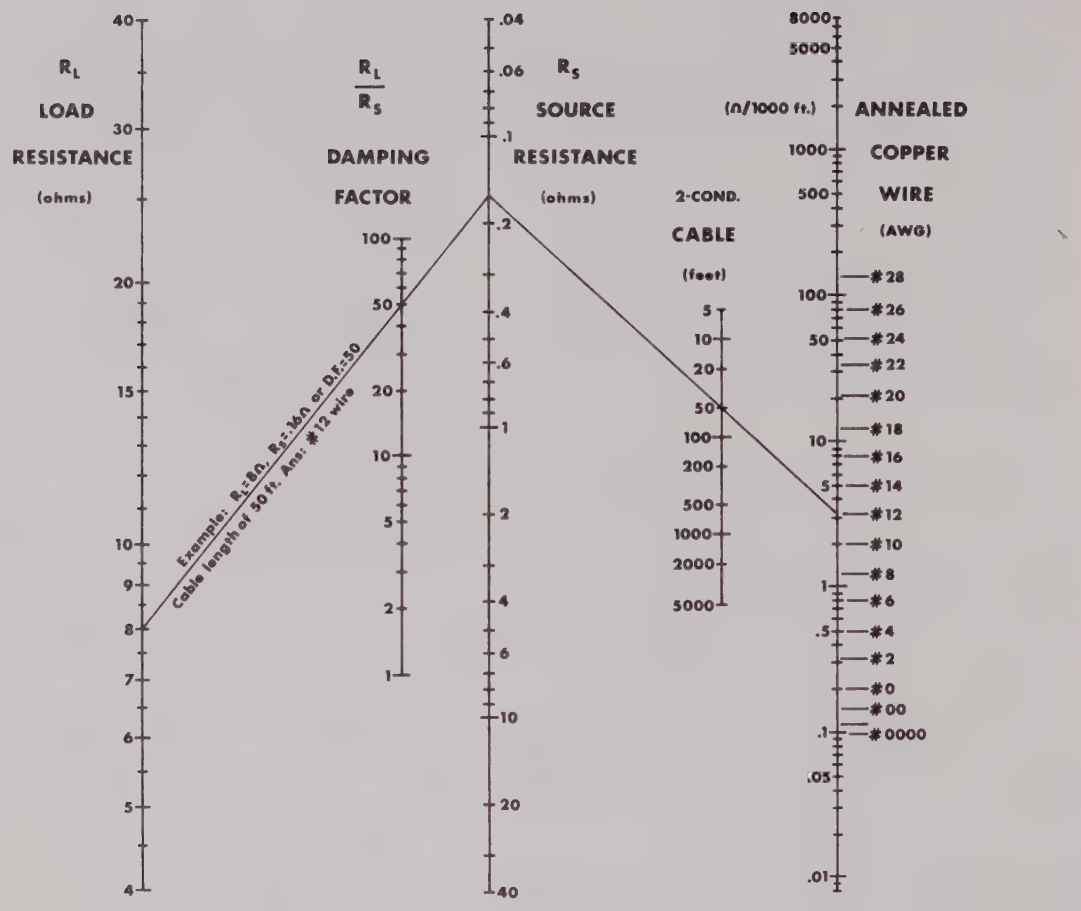


FIGURE 2-6
SOURCE RESISTANCE and DAMPING FACTOR VS. LENGTH and SIZE of OUTPUT LEADS

When selecting connectors for the load (speaker) end of the output lines, the following general precautions apply (with all power connectors):

1. A male plug, carrying signal, must not be on the far end of the line where it can be exposed, giving rise to both shock and short-circuit hazards.
2. Connectors which might accidentally cause the two channels to be tied together during making and breaking of connection should not be used. A common example is the standard 3-circuit ¼-inch phone jack and plug when wired for stereo sound.
3. Connectors which can be plugged into AC power receptacles should **never** be used.
4. Connectors having low-current-carrying capacity are "verboten".
5. Connectors having any tendency to short, or having shorted leads, are unadvisable.

Most commercially-available headphones employ a 4-circuit ¼-inch phone plug which violates condition No. 2. This is no handicap if a pad is inserted between the amp and jack, which is only a sensible thing to do, when such a large amplifier is coupled to such a small transducer. If this precaution is ignored, not only may the transducer be burned out but permanent hearing loss could result. The recommended pad is shown in Figure 2-7.

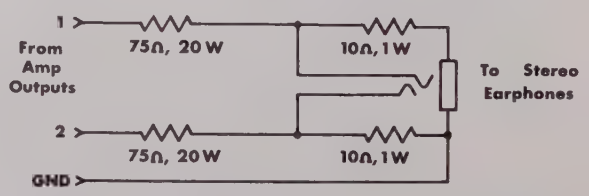


FIGURE 2-7
SCHEMATIC OF EARPHONE PAD

2.4.1 Mono Operation

A mono-stereo switch on the rear panel adjacent to the input jacks, allows the D-150A to be operated normally (stereo) or in mono, with no internal modification. (See figure 2-4.) When in the mono position, the input circuitry of the D-150A is changed so that the two amplifiers are "added" for mono output. (See mono specifications, page 3).

Care must be taken in the external hook-up to assure proper operation. Proceed as follows:

1. The input line should be plugged into the channel 1 input jack. The level is adjusted with the channel 1 input level control.

   NOTE: The Channel 2 input jack and level control are not defeated in the Mono mode. However, the Channel 2 input should not be used in this mode. If a Channel 2 input is added to the Channel 1 input, distortion may result. If Channel 2 input is used alone, very low power output will result. For best results unplug the input to Channel 2 when operating Mono.

2. Connect output lines as per the following drawing, Figure 2-8. The output from the D-150A in Mono is **BALANCED** and is isolated from the chassis, and from the input grounds to the D-150A.

   CAUTION: Be certain that all equipment (meters, switches, etc.) connected to the Mono output lines is balanced. Both sides of the line must be totally isolated from the input grounds, to the D-150A. If this is not observed, severe oscillation may result.

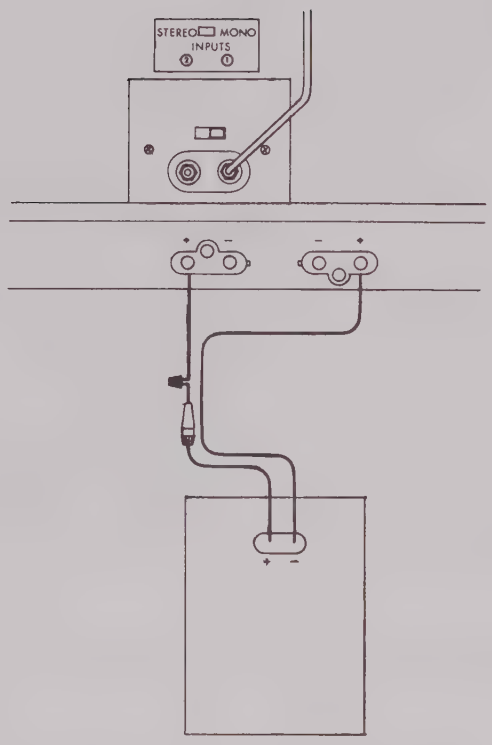


FIGURE 2-8
D-150A MONO HOOK-UP

2.5 CONNECTING INPUT LINES

Connecting the inputs will require observance of three basic precautions: Undesirable signals to the inputs, "ground loops," and feedback from output(s) to input(s).

In high-fidelity audio applications any good vacuum-tube or solid-state control center will operate successfully into the 25K ohm inputs of the D-150A. Occasionally a high-impedance output of poorly-designed preamps will be encountered, and/or a larger output coupling capacitor may be required (to prevent excessive low-frequency roll-off).

For loudspeaker-driving applications, the input should be free of DC or large sub-audio or undesired low frequencies, as they cause overheating and overloading of the loudspeaker. To remove such low frequencies, a series capacitor may be placed in the input signal line. (The graph of Figure 2-9 indicates the effect of the size of the capacitor on the frequency response.) Only a low-leakage paper, mylar, or tantalum capacitor should be used for this purpose.

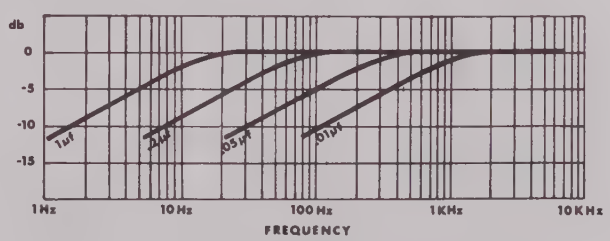


FIGURE 2-9
GRAPH FOR SELECTION OF INPUT CAPACITOR

If large amounts of ultrasonic or RF frequencies are found on the input, such as bias from tape recorders, etc., a low-pass filter should be placed on the input. While practically-obtainable RF input levels will not damage the amplifier, they may cause burn-out of

tweeters or other sensitive loads, activate the amplifier's protective systems, or cause general overload in the controlled-slewing-rate stage of the amp (which is employed to provide RF overload protection). The following filters are recommended for such applications.

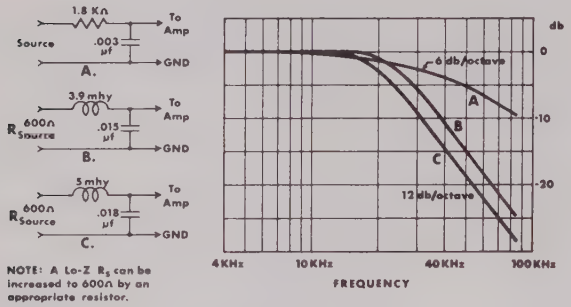


FIGURE 2-10
LOW-PASS FILTERS
FOR SEVERE RF AT INPUTS

A second precaution is "ground loops" — electronic jargon for undesirable circulating currents flowing in a grounding system. A common form of loop (possibly resulting in hum in the output) is a pair of input cables whose area is subjected to a magnetic hum field. In practice, both cables should lie together along their length, and away from the power transformer. Tying the input and output grounds together may also form a ground loop.

A third precaution (with input and output grounds together, as in testing or metering) is feedback oscillation, from load current flowing in the loop. In industrial use, even the AC power line may provide this feedback path. Proper grounding, and isolation of inputs, of common-AC-line devices is good practice. Refer to Section 4.2, paragraph 5 for testing precautions.

2.6 CONNECTION POWER

The amplifier is furnished with a three-wire AC plug as standard equipment. Adapters are readily available commercially for adapting this to a two-wire system if necessary.

The amplifier offers five standard line-voltage connections: 100, 120, 200, 220, and 240VAC. The tag attached to the line cord indicates for which voltage the amplifier is connected. Most units are connected for 120VAC. For operation at another line voltage, the unit must be converted to the proper input connection. Follow the following steps:

1. Remove the two end bars or rack ears from the front panel (4 socket cap screws).
2. Remove the front panel (6 screws).
3. Position the front panel to gain access to the transformer leads. Locate the two terminal strips (terminals A, B, C, D, E).
4. Determine the correct connection from Figure 2-11 and solder the leads accordingly. Conversion instructions are also included with a voltage conversion chart on the fold-out schematic at the rear of this manual.
5. Carefully check all connections, then repeat steps 1 and 2 in reverse.

NOTE: For all connections 200VAC and above, the line fuse, F1, is changed to 3 amps.

When testing the amplifier, the line voltage must be the peak equivalent to a sinusoid of the indicated line voltage when at full load. Line regulation problems can introduce serious errors in the measurements on an amplifier of this size.

Only a competent technician should attempt alteration of the line voltage connections.

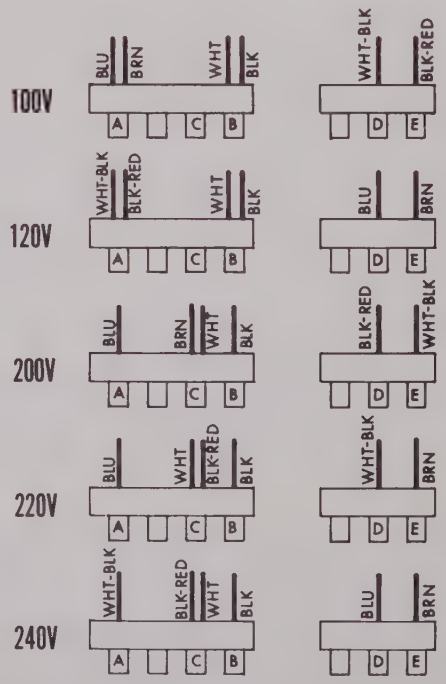


FIGURE 2-11
TABLE OF LINE VOLTAGE CONNECTIONS

OPERATING INSTRUCTIONS

3.1 CONTROLS AND ADJUSTMENTS

FIGURE 3-1
OPERATING CONTROLS

The D-150A contains all the facilities essential for a high performance amplifier.

On the front panel are located independent level controls, a power switch, and a pilot light. There is an AC line fuse on the rear of the unit.

The input level controls should be adjusted for the desired output level. Amplifier gain is 26 dB as determined by 1% previous resistors in the D-150A's feedback loop.

The DC balance controls located under the perforated cover seldom, if ever, need adjustment. **Only** in the most critical applications will they need adjustment (**not** "hi-fi" or similar applications). To adjust the DC balance controls, use the following procedures (see Circuit Board layout in Section 4):

1. Make sure amp has been allowed at least 15 minutes of warm-up.
2. Set corresponding **level control** fully CCW.
3. Remove input signal from corresponding input.
4. Place sensitive DC voltmeter across output.
5. Adjust output balance control using small flat-bladed screwdriver for zero reading on voltmeter.
6. Turn **level control** CW to 12 o'clock.
7. Adjust input balance control using small flat-bladed screwdriver for zero reading on voltmeter.

The DC balance controls are now adjusted.

3.2 THE PROTECTION MECHANISMS

The D-150A is protected against all the common hazards which plague highpower amplifiers, including shorted, open, and mismatched loads; overloaded power supplies; excessive temperature; chain destruction phenomena; input overload damage; and high frequency overload blowups.

Protection against shorted and low impedance loads is provided by the Signal Programmed Automatic Current Executor (SPACE control). It functions as an automatic current limiter at audio frequencies whose value of current limiting threshold is dependent on the history of the output signal. Output current causes the threshold to decrease while output voltage causes the threshold to increase. The no signal threshold is high enough to allow tone bursting, (even into 4 ohms) without premature limiting as is found in some recent products of other manufacturers.

Since the limiter has no instantaneous response to output voltage, flyback transients do not appear in the output when limiting occurs on inductive loads. Flyback transients are a necessary response of a VI limiter (sometimes misnomered an "Energy Limiter") when limiting drive to an inductive load. The actual response of the flyback pulse is that the amplifier yields to the load resulting in a pulse emanating from the load which returns the inductive energy of the load to the opposite polarity power supply of the amplifier as that supply that produced the excessive output. The audible effect of flyback

pulses is to produce a rasping, popping sort of sound which is not pleasing.

A current limiter will not yield to the load but will sustain the constant current demands of the inductive load without flyback.

Early amplifier designs frequently employed fixed current limiters but had serious difficulty with obtaining reliable low frequency output while being capable of full-voltage 4 ohm output. Also, many earlier designs used fragile epi-base or triple diffused outputs, which for reliable performance are poor mates for a current limiter protection scheme. The D-150A uses two multiple epitaxial silicon power transistors per channel. Their toughness allows the reliable use of a current limiter which when rendered signal variable permits larger power outputs than would be safely allowable with a current limiter of fixed type.

At subsonic frequencies, the SPACE control behaves as a VI limiter and provides the increased protection needed at DC to prevent destruction due to heat build-up in the half of the output stage that is being driven.

The AC line for 120VAC is fused with a 6.25A, type MDX fuse (on 240, 240VAC, 3A type MDA). The use of any other type of fuse will invalidate the warranty.

On the chassis is mounted a thermal switch which protects the amplifier against insufficient ventilation. If it becomes too hot, the AC line power will be interrupted until the temperature falls to a safe level, whereupon power will automatically be restored. When such an event occurs the external symptoms are: no output, and a warm amplifier.

All the amplifier's voltage-amplifiers circuitry is designed to be inherently current-limited. Thereby, if any of the devices should fail, (which is extremely unlikely), no damage will occur to the rest of the stages.

The input stage is protected against overdrive damage by a series limiting resistor should the input signal level ever become very excessive.

The amplifier features a controlled slewing-rate which, coupled with the SPACE controller, protects the amplifier from blowups when fed large RF input signals.

3.3 OPERATING PRECAUTIONS

The following are a number of operating precautions given as an aid to understanding proper and improper amplifier usage:

1. Use care in making connections, selecting signal sources, and controlling the output level. The loudspeaker you save may be your own. CROWN is not liable for any damage done to loads due to careless amplifier usage or deliberate overpowering. For pointers on load protection see Section 3.4.
2. Never parallel the two outputs by directly tying them together or parallel them with any other amp's output. Such connection does not result in increased power output. Damage incurred by such operation is not covered by the warranty.
3. Never drive a transformer-coupled device or any other device which appears as a low frequency short (less than 3 ohm) without a series isolating capacitor. Such operations may damage the device and/or needlessly activate the V-I limiting (see Figure 2-5).
4. Do not short the ground lead of an output cable to the input signal ground as oscillations may result from forming such a ground loop.
5. Operate and fuse the amplifier only as set forth in Section 3.2.
6. Operate the amplifier from AC mains of not more than 10% above the selected line voltage and only on 50, 60 or 400Hz AC. Failing to comply with these limits will also invalidate the warranty.
7. Never connect the output to a power supply output, battery, or power main. Damage incurred by such a hookup is not covered by the warranty.
8. Do not expose the amplifier to corrosive chemicals such as soft drinks, lye, salt water, etc.
9. Tampering in the circuit by unqualified personnel or the making of unauthorized circuit modifications invalidates the warranty.
10. Do not expose the output leads to areas likely to be struck by lightning. Such an installation could invalidate the amplifier.

3.4 LOAD PROTECTION METHODS

The most common of all protection schemes is a fuse in series with the load. The fuse may be single, fusing the overall system. Or, in the case of a multi-way speaker system, it may be multiple with one fuse on each speaker.

Fuses help to prevent damage due to prolonged overload, but provide essentially no protection against damage that may be done by large transients and such. To minimize this problem, high-speed instrument fuses such as Littlefuse 361000 series are most appropriate for such applications. For a nomograph showing fuse size vs. loudspeaker ratings refer to Figure 3-2.

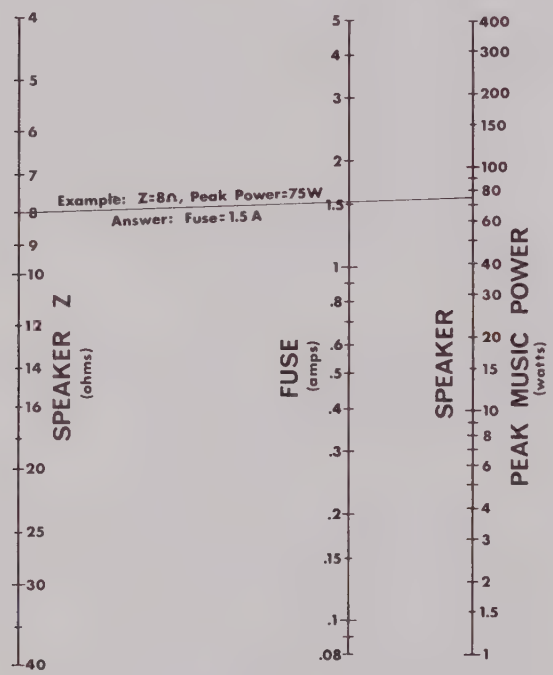


FIGURE 3-2
FUSE SELECTOR NOMOGRAPH FOR LOUDSPEAKER PROTECTION

Another form of load protector is shown schematically in Figure 3-3. Whenever the load is overdriven, a relay switches a lamp in series with the load, smoothly relieving the overload. The lamp then doubles as an overdrive indicator as it glows. If overdrive is unreasonably severe, the lamp will serve as a fuse. By adjusting the relay tension adjustment and the protection level control, this system is useful from 25 to 200 watts for a typical 8 ohm load.

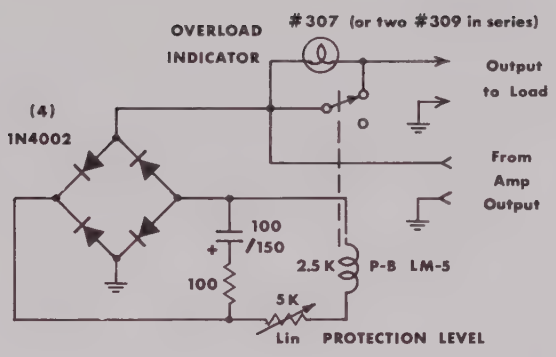


FIGURE 3-3
RELAY-CONTROLLED PROTECTOR WITH OVERLOAD INDICATOR

A common problem which causes damage and irritation is the turn-on thump problem typical to many signal sources. Figure 3-4 shows the schematic of a muter which, when inserted in the input signal line, mutes for several seconds before connecting the source to the amplifier, thereby eliminating turn-on transients. It also removes turn-off transients occurring after the relay drops open (=0.1 sec.).

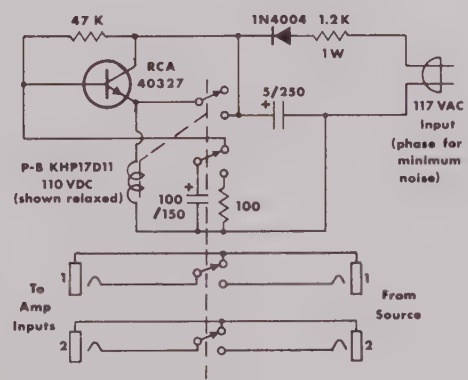


FIGURE 3-4
TURN-ON TRANSIENT MUTER FOR LOAD PROTECTION

NOTE: When using the CROWN IC-150 this muter is not required. A built-in muter protects your speakers from any signal source whose AC power is switched by the IC-150.

3.5 CLEANING

The CROWN D-150A has a rugged anodized front panel for life-time service. The panel can be cleaned with a moist cloth and mild detergent. Never use steel wool, scouring powder, lye solution, or any strong abrasive cleaner as these will damage the panel's finish.

CIRCUITRY

4.1 PRINCIPLES OF OPERATION

The D-150A has two totally direct-coupled amplifier circuits which employ a dual IC op amp and silicon transistors in all stages. The CROWN-designed and developed circuit represents a level of quality and performance presently unequaled in the field of audio amplifier design.

As is implicit in the term "totally direct-coupled," the D-150A has a perfectly flat frequency and phase response extending to 0Hz or DC. Flat to DC response results in not only low frequency amplification with absolutely no phase-distortion, but also in perfect overload characteristics. Non-symmetrical waveforms (such as music) cause overload thumping in all currently produced AC amplifiers. These same amplifiers may, however, show no signs of thumping when fed a symmetrical test waveform such as a sinusoid. DC frequency response combined with ultra-low noise and IM distortion results in the closest approach to a "straight wire with gain."

Another characteristic of a DC amplifier is the thump or pop produced at turn-on and turn-off. For example, at turn-on the input amplifier requires a finite period of time to reach operating levels. During this time the output could be driven to large DC offsets resulting in annoying thumps.

A supply voltage detector virtually eliminates this problem in the D-150A. The detector disconnects the regulated supply voltages to the output stages during these turn-on and turn-off periods, thus not allowing the DC offsets at the output to occur.

The dual IC op amp is of a low noise type having a large gain bandwidth. The result of using it for the input voltage amplifier is that a maximum amount of feedback is applied reducing distortion to record low values. This has been confirmed by measurement with an elaborate test setup employing CROWN-developed solid state variable filters and wave analyzing equipment. No other presently available harmonic distortion test apparatus is capable of such low residuals. The 150A's low distortion is achieved by employing multiple feedback loops to allow a maximum of total feedback.

The lack of noise is evidenced by a typical 20Hz-20KHz effective input noise of 1.25u volts which produces an effective 8 ohm output of 80 micromicro (pica) watts.

The output stage is a quasi-complementary format employing the CROWN class AB+B technique which uses no bias current in the output transistors. The result is maximum efficiency with minimum crossover notch distortion and amplifier idling heat. Thus there is no bias current adjustment, as the output circuit is not temperature-tolerance critical. Temperature drifts of bias are further controlled by bias servos which are mounted on the heat sinks.

In the AB+B output circuit, the driver transistors carry the bias current, while the output transistors serve only as boosters. The output transistors sense when the driver transistors are delivering significant current to the load and take over and deliver the large load currents.

Protection against shorted and low impedance loads is provided by the CROWN-developed SPACE (Signal Programmed Automatic Current Executor) control circuit. It functions as an automatic current limiter at audio frequencies and as a VI limiter at subaudio frequencies. The threshold of current limiting is dependent on the history of the signal, yet the no-signal threshold of current limiting is high enough to allow full power tone bursting. The net result is total protection with a maximum of headache-free output power requiring neither an inventory of special fuses or cumbersome load matching techniques.

The monolithic input amplifier stages result in extremely low DC drift. The input terminal bias current is offset by a unique temperature compensated source resulting in a laboratory amplifier needing no user-accessible offset controls.

The input amplifiers are powered by zener-regulated power supplies. The bias regulators are also powered by zener-regulated current sources with the result that line voltage variations do not cause noise or distortion due to misbiasing.

The power supply is a continuous-duty type. The main DC supplies are full-wave capacitor input type with heavy-duty, chassis heat-sinked diodes. Computer grade electrolytics furnish over 20 joules of energy storage. A higher voltage at low current is derived from a half-wave voltage-doubler circuit. This voltage is used in the amplifier's driver circuit.

The D-150A represents nothing short of the highest quality in both circuitry and components. It should provide a lifetime of trouble-free service for the most discriminating users.

4.2 TEST PROCEDURES

The sole function of this section is to list precautions essential to obtaining accurate measurements when dealing with high-power, high-purity amplifiers such as the D-150A.

1. Use the proper line voltage, which is the one for which the amplifier is connected. The voltage should be measured throughout the testing with a peak reading meter, and adjusted to the RMS equivalent voltage (to compensate for line voltage regulation errors during the course of the measurements). All measurements should be taken at the power amplifier's plug. When

testing for IHF music-power measurements, the line voltage is to be set at 120V when the amplifier is connected to 120V, (IHF standards). If the amp is connected for 240V equivalent test may be given by applying 240 volts.

2. The load should be resistive, having less than 10% reactive component at any frequency up to five times the highest test frequency. The resistor should be capable of continuously dissipating the full output of the amplifier while maintaining its resistance within 1% of its rated value. The load should employ only high-current connectors (if any), and be connected to the binding-post output terminals. All output measurements should be taken at the amplifier output terminals, and not anywhere along the output cable through which the load current is flowing.

3. The input level controls should be set to maximum for all distortion tests to assure repeatability of all measurements.

4. When measuring hum and noise, all inputs should be disconnected from the amplifier and the level controls set to minimum or to maximum, preferably minimum.

5. Whenever possible avoid ground loops in the test equipment caused by connecting the output ground to the input ground. **Never** connect the ground of the cable going to the load back to the input ground.

   Ground loops are especially obnoxious when measuring distortion. An I-M distortion analyzer, for example, has its input and output terminals tied to a common ground. Such a test should use an ungrounded output return, with the output lead(s) wrapped around the well-shielded and grounded input cable.

6. Always monitor the test oscillator when measuring frequency response. Use a wide-band AC voltmeter, or use the same meter for both input and output level measurements, if the meter's frequency response is known not to be dependent on attenuator settings.

7. Accuracy in measuring voltages for computing wattage is critical. For example, a 2% voltage error together with a 1% resistance error can result in an error of 5 watts power into 8 ohms.

8. Residual distortion and noise levels should be fully known for all the test equipment in order to accurately evaluate the amplifier.

9. Never attempt to measure damping factor by placing abnormal loads on the output. D-F measurements taken during clipping, or any other form of overload, are meaningless. The preferred method is to apply an externally generated current to the output terminals and measure the resultant voltage at the terminals. A convenient current is one ampere — as the resultant voltage will read directly in ohms for $|Z_O|$. Damping Factor is defined as $\left|\frac{Z_L}{Z_O}\right|$, where $|Z_L|$ is typically 8 ohms. A convenient generator for the 1A. current is that amplifier channel not under test. A non-inductive resistance of 8 ohms — coupled between both channels' output terminals — will provide 1A. when 8 volts are impressed across the resistor (by that channel not under test).

10. Never measure hum and noise when in the presence of strong magnetic fields. The amplifier should be at least 4 inches away from any large metallic objects or shield plates for a reading to be meaningful.

11. Noise measurements should be taken with a band-pass filter of 20-20KHz. For audio purposes the measurement of noise above 20KHz is meaningless.

4.3 SERVICE

Should service other than routine fuse replacement ever be required, it is recommended that the unit be returned to the factory in the original packing (or replacement, if damaged). For warranty service the machine must be returned to the factory or warranty stations. The CROWN warranty is detailed on page 7.

Because of the level of circuitry sophistication of the D-150A, only the most competent technicians should be allowed to service it.

Many of the parts are standard items stocked by most supply houses. However, there are several which appear to be standard parts but are actually different. Although standard parts may be used in an emergency, best results will be with factory parts. A number of the parts are available only from CROWN.

When ordering parts, be sure to give the amplifier serial number as well as the part number and description. Rated firms will be billed, otherwise shipments will be C.O.D.

Before returning an amplifier to the factory for service, authorization should first be obtained from the service manager. All shipments must be sent by UPS or truck freight, prepaid and insured at total value. The factory will return your serviced unit by UPS or truck freight, collect, and will add C.O.D. charges in the event that the cost is not covered by registered warranty.

APPLICATION NOTES

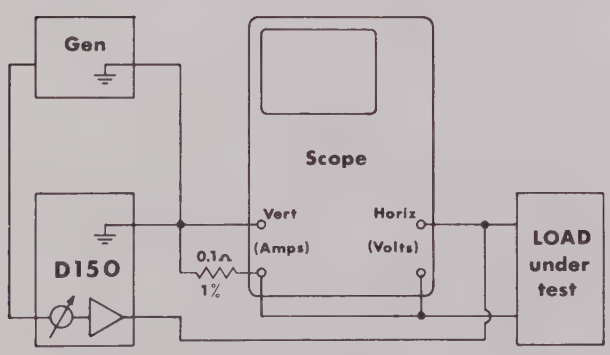
APPLICATION NOTE 1

Evaluating the V-I (volt-ampere) needs of a load: Many loads exhibit large reactances (or energy storage), which limits a power amplifier's ability to deliver a maximum power. If a load stores energy, which in turn flows back into the amplifier, it is clear that the maximum power efficiency of the system is not being achieved. Power that flows back into a linear amplifier must necessarily be dissipated in the form of heat. A pure reactance is not capable of dissipating any power; therefore, to drive such a load would only cause power amplifier heating.

In practice all loads exhibit some energy dissipation — however large their energy storage characteristics may be. The ideal coupling to any load is one that optimizes the desired dissipation component while minimizing the reactive or stored-energy component that is seen by the amplifier's output terminals.

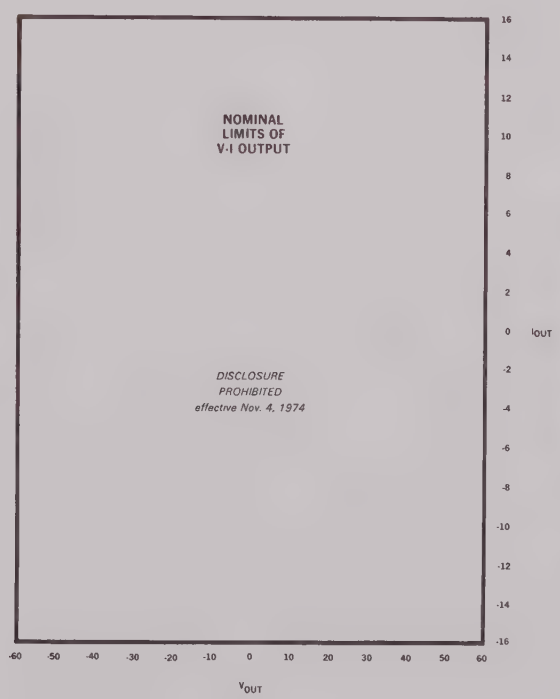
In applications where the input is sinusoidal and of small proportional frequency deviation, a relatively stable load may be resonantly tuned to present a real value of impedance to the amplifier.

Any load, no matter how complex its behavior, has a V-I operating range which may be mapped by the following test.



The maximum voltage and amperage excursions in all directions about zero (center of scope screen) define the volt-ampere operating range of the load. If a load is known to be linear over its operating range it is not necessary to supply the maximum desired power to the load. The test may be conducted at low signal levels and the current-sensing resistor (indicated as 0.1 ohm) may be enlarged to a convenient value for the oscilloscope's deflection sensitivity. The resulting plot may be then linearly scaled to the desired operating level.

In the following example a reactive load is being fed a sinusoid of varying intensity. The V-I limits of the amplifier are super-imposed in dotted lines.



APPLICATION NOTE NO. 2

WARNING

POWER AMPLIFIER PROTECTION SYSTEMS PROTECT AMPLIFIERS BUT NOT SPEAKERS! YOU, AND/OR YOUR SPEAKER MANUFACTURER ARE RESPONSIBLE FOR SPEAKER PROTECTION!

Except in unusual sets of circumstances, the circuitry included in power amplifiers designated as "protection", whether made up of transistor limiters, circuit breakers, fuses, SCR's, or whatever, is designed primarily to protect the amplifier from damage and will only protect speakers incidentally. There are some exceptions to this rule, which allow the user to vary the output power limits of his amplifier to match the power rating of his speakers. Even this, however, is a far from perfect speaker protection scheme. The reason why this holds true is simple: each make or model speaker has its own unique operating capabilities. As a rule, a speaker system (including all electronic parts such as crossover parts and electrostatic element transformers, as well as voice coils) will be able to dissipate a certain amount of power continuously without burning up. This depends on the size, quality, configuration, etc., of those parts. The same speaker will be able to handle a somewhat higher power level for a short period of time (in the millisecond range) without being destroyed by heat, but may then be endangered by such phenomena as extending moving elements beyond their normal range of travel (bottoming, torn diaphragm, etc.), overvoltaging electrostatic panels (arcing), or other such suddenly disabling events. Since the points at which these disastrous happenings will occur, differ for different speakers, a speaker protection system must be completely adjustable if it is to be useful for more than a narrow range of speakers. Furthermore, if the user is to be able to do adequate adjustment on a protection system external to his speakers, he must receive accurate information about the speaker power handling capabilities from the speaker manufacturer. Speaker protection systems embodied in amplifiers are comparatively useless, therefore, unless the following things are true:

(1) The protection system can be accurately adjusted by the user.

(2) The power handling capabilities of the speakers are clearly stated by the manufacturer.

(3) The information about the speaker protection and speaker power handling are stated in common terms so that the user can adjust the protection properly for the speaker.

These three things are rarely true simultaneously. It is for this reason that CROWN takes the approach that speaker protection is the responsibility of the speaker manufacturer. Amplifier manufacturers have long been required to provide protection in their products for any faults occurring externally to the amplifier outputs, such as speaker short circuits, open circuits, etc. In order to fairly share the responsibility, and since the protection cannot be exhaustively provided any other way, we feel that speaker manufacturers should provide protection tailored to their individual products. At CROWN we have done this with our own speakers, simply because it is the only comprehensive means of providing worthwhile protection for all of our speakers.

Increasing power available from modern amplifiers increases the danger of speaker damage. Although occasionally an internal amplifier malfunction can contribute to speaker failure, it is much more likely that speakers will be overpowered by inadvertent use of too much power. In the absence of internal protection in most speaker systems, CROWN recommends very strongly that in-line speaker fuses be employed in all systems. The fuse selection nomograph reprinted in each CROWN amplifier manual can be an invaluable help in choosing fuses of the proper size. However, the effectiveness of fuses in protecting speakers is limited in two important ways:

(1) Fuses as a rule protect only against prolonged overpowering, and can only prevent speakers from being driven with more than their RMS or average power rating. Fuses cannot protect against sudden high level transients of short duration. The use of high-speed instrument fuses will give the best protection available from fuses, but musical transients can have an effect before the fastest fuses blow.

(2) An appropriate fuse can only be selected if the manufacturer's specifications for his speaker are accurately and clearly stated. If a speaker can handle 100 watt peaks and 30 watts continuously, but is advertised, and therefore fused, as a 100 watt speaker, then the speaker will destroy itself before the fuse can protect it under a continuous power level above 30 watts.

There are more effective (also more complicated and expensive) methods of protecting speakers than fuses. Some of these, including methods similar to those employed in CROWN speakers, are illustrated in the load protection section of CROWN amplifier manuals. But these systems, as all others, must still be adjusted in accordance with the power-handling capability of the speakers in use, and this can still be most readily done by speaker manufacturers.

Your speakers have probably cost you at least as much as any other part of your audio system. And since speaker sound continues to be the most subjective area of component selection, you may also have devoted more time and effort to selecting your speakers than you have devoted to any other part of your system. With these facts in mind, be extremely careful in providing for adequate protection of these often fragile, but most important, expressions of your audio taste.

Schematic Designation	Description	Crown Part #	Other Information
	MAIN MODULE	41603	
	Capacitors		
C100, C200 C106, C206	100 PF Mica	3410	
C101, C201	.001 MF 200V Filmatic	3480	
C110, C210	.0027 MF 200V Filmatic	3481	
C102, C202 C103, C203 C107, C207 C114, C214	200 PF Mica	3411	
C104, C204 C117, C217	47 PF Mica	3409	
C105, C205	120 PF Mica	3290	
C108, C208 C109, C209	25 MF 15V NP	3186	
C111, C211	470 PF Mica	2511	
C112, C212	.0022 MF 200V Filmatic	3285	
C113, C213 C6	.01 MF Cer Disc	1751	
C4	10 MF 160V	2796	
C5	10 MF 50V Vertical	3728	
C7	100 MF 16V Vertical	3729	
	Resistors		
R100, R200	100K Horiz PC Pot	1709	Output offset
R101, R201	2M ohm ¼ watt 5%	3199	
R102, R202	250K log taper PC pot	3087	Input offset
R103, R203 R114, R214	1K ohm ¼ watt 10%	2627	
R104, R204	820K ohm ¼ watt 10%	3623	
R106, R206	4.7K ohm ¼ watt 10%	3939	
R107, R207	56 ohm ¼ watt 10%	3511	
R108, R208	3.3K ¼ watt 10%	2629*	2629 is used when IC-1 is uA749. See IC-1 under semiconductors.
R109, R209	510 ohm ½ watt 1% MF	3304	
R110, R210	2.4K ohm ¼ watt 5%	3616	
R111, R211	56K ohm ¼ watt 10%	2882	
R112, R212 R5	8.2K ohm ¼ watt 10%	2877	
R113, R213	5.6K ohm ¼ watt 10%	3220	

Schematic Designation	Description	Crown Part #	Other Information
R115, R215 R11	10K ohm ½ watt 1% Film	2343	
R116, R216	820 ohm ¼ watt 10%	3301	
R117, R217	33K ½ watt 5%	3137	
R118, R218 R123, R223	120 ohm ½ watt 5% Film	3837	
R119, R219 R122, R222	82 ohm ¼ watt 5% Film	3960	
R120, R220	5.1K ohm 1 watt 5% Film	2808	
R121, R221	27K ohm ½ watt 5% Film	3970	
R124, R224	82 ohm ¼ watt 10%	3300	
R125, R225	2.2K ohm ½ watt 5% Film	3145	
R126, R226	750 ohm ¼ watt 5%	3803	
R127, R227	15 ohm ¼ watt 10%	3614	
R128, R228	Selected		
R129, R229, R13	47 ohm ¼ watt 5%	1011	
R130, R230 R135, R235	180 ohm ¼ watt 10%	2873	
R131, R231 R136, R236	5.6 ohm ½ watt 5%	3299	
R137, R237	180K ohm ¼ watt 5% Film	4218	
R2	2.2K ohm ½ watt 10%	1036	
R3	1.5K ohm 2 watt 10%	3303	
R4	200K ohm ¼ watt 5%	3622	
R6	91K ohm ¼ watt 5%	3621	
R7	6.2K ohm ¼ watt 5%	3619	
R8	2.7K ohm 1 watt 10%	1079	
R10	390 ohm ½ watt 10%	2609	
	Semiconductors		
Q1 Q103, Q203 Q106, Q206 Q111, Q211	Selected 2N3859A	2961	
Q100, Q200 Q104, Q204 Q108, Q208	2N4125	3625	
Q101, Q201 Q2	PN4250A	3786	

Schematic Designation	Description	Crown Part #	Other Information
Q102, Q202	MPSA93	3578	
Q105, Q205	MPSL01	3232	
Q107, Q207	NSD106	4069	
Q112, Q212	NSD206	4116	
D1, D2 D106, D206 D102, D202	1N4003	2851	
D3, D4, D5	1N961B 10V Zener	3549	
D107, D207	1N270	3447	
D100, D200 D101, D201 D103, D203 D104, D204 D105, D205	1N4148	3181	
IC-1A, B	Dual uA739PC OP AMP	3231*	
IC-1A, B	Dual uA749 OP AMP	3643*	*NOTE: R108, 208 are omitted when uA739 is used, and 3.3K when uA749 is used. See R108, 208 under resistors.
	Miscellaneous		
L100, L200	.5 MH axial lead choke	3510	
	Main PC board	9604	
	TO-92 D-clip	3953	Mounts over Q111, Q211
	D-150A PC board mount bracket	9562	Fastens 3953 to PC board
	#6 internal star washer	1823	Used to mount 9562.
	6-32 hex nut	1889	Used to mount 9562.
	6-32 x ⅜ BHP screw	2134	Used to mount 9562.
	Dual TO-92 cooler	3493	Mounted over Q102, Q202.
	14 pin DIL IC socket	3450	Socket for IC-1.
	Transistor lead PC receptacle	3519	Used to mount R128, R228.
L102, L202	**OUTPUT INDUCTOR ASSY.**	40959	
	Output coil, torroid form	2850	
	Nylon washer	3609	One on each side of coil.
	#16 brown wire	2812	
	#8 int. star washer	1951	Used to mount coil

Schematic Designation	Description	Crown Part #	Other Information
	8/32 hex nut	1986 CAD	One on each side of coil
	8/32 x 1¾ stud screw	3324	Used to mount coil.
	806 solder lug #10 hole	3312	Mounts under one coil in place of star washer.
	505 solder lug #8 hole	2935	Mounts under cover spacers.
	CONTROL PLATE ASSY.	41554	
R9	1 ohm ½ watt 10%	3612	Installed at test bench if needed to suppress low frequency oscillation.
	D-150A Switch - Jack Plate	9595	
	112A 2 cond. Hi-D jax	3423	Input jacks.
	⅜" fiber shoulder washer	1306	Used to mount jacks.
	Fiber washer	1646	Used to mount jacks.
	⅜" bright control nut	1288 NIC	Used to mount jacks.
	Bright control washer	2189 NIC	Used to mount jacks.
	8-32 Captive Nut	2018	Mount on underside of 9595 plate.
SW3	DPDT slide switch	4110	Mono - Stereo Switch.
	Eyelet	3529	Used to mount SW3.
	4.1 hex standoff	3961	Used to mount plate.
	Solder lug, #8 hole	2935	Mount between spacers and chassis; (spacers mount to stud screw from output inductors on bottom of chassis).
	8/32 x ¼ FHP Screw	2136 CHR	Fasten control plate.
	½" foam tape	2859	Sticks onto control plate.
	CHASSIS ASSEMBLY		
	D-150A chassis	3544	
	3 #18 8' power cord male	3474	
	Heyco strain relief	2803	Used to mount PC.
	Dual binding posts	2823	Output terminals.
	HTA fuseholder	3256	
F1	MDX 6.25A fuse	4307	Used in 120VAC units. Starts SN 19960.
F1	3A fuse	4384	Used in 240VAC units. Starts SN 19960.
	3823-1 fuse block	3776	Internal fuseholder (CSA)
F2	MDX 7A fuse	4385	Internal fuse (CSA) used for both 120/240VAC. Starts SN 19960.
T1	D-150A transformer 9549 P2	4380	Starts SN 19960.
	10-32 x ¾ THP screw	2557	Used to mount one end of T1.

Schematic Designation	Description	Crown Part #	Other Information
	10-32 x ½ THP screw	2049 NIC	Used to mount one end of T1.
	#10 internal starwasher	2279	Used to mount T1.
	10-32 hex nuts	2170	Used to mount T1.
	2-G-2 terminal strip	4249	
	1-G-2 terminal strip insulator	3599	Mounts over one 2049.
	2-G-1 terminal strip	3323	
	D-150A end cover (transformer side)	9565-S	Mounts over two transformer screws.
	D-150A end cover (PC board side)	9566-S	Mounts under heat sink screws.
C23, C24	9,400 MF 50V Cap	3309	
	10-32 x ½ THP Screw	2049NIC	Used to mount C2, C3
	Panel washer	2101	Used to mount C2, C3
	Solder lug	2934	Used as terminals on C2, C3
	5/16 Fiber shoulder washer	3320	Used to mount C2, C3
DM1	MDA3502 35A bridge	4305	
	6-32 x .625 BHP screw	3879	Used to mount DM1
	#6 internal star washer	1823	Used to mount DM1
	6-32 hex nut	1889 CAD	Used to mount DM1
SW1	SPST NC 160F Thermal Switch	2799	
R12	390 ohm 2W 5%	4029	May be trimmed with a 1K ohm resistor, CPN 3615.
	6-32 x .625 BHP screw	3879	#6 hardware used to mount 2799 and 9562 PC board mount bracket.
	#6 internal star washer	1823	
	#6 solder lug	3163	
	6-32 hex nut	1889 CAD	
	Faston flag terminal	3298	Used on DM1, C2, C3, thermal switch.
	Faston flag housing	3297	Used on DM1, C2, C3, thermal switch.
Q109, Q209 Q113, Q213	Selected 2N3585	3295	Driver transistors.
	TO-66 insulator	4113	Used to mount drivers.
	TO-66 alum. wafer	4352	Used to mount drivers.
Q110, Q210 Q114, Q214	Selected T6J0377 (Fairchild)	3941	Output transistors.
Q110, Q210 Q114, Q214	2N 5631 100V (Motorola)	3990	Output transistors.
	Anodized TO-3 insulator	4039	Used to mount outputs.

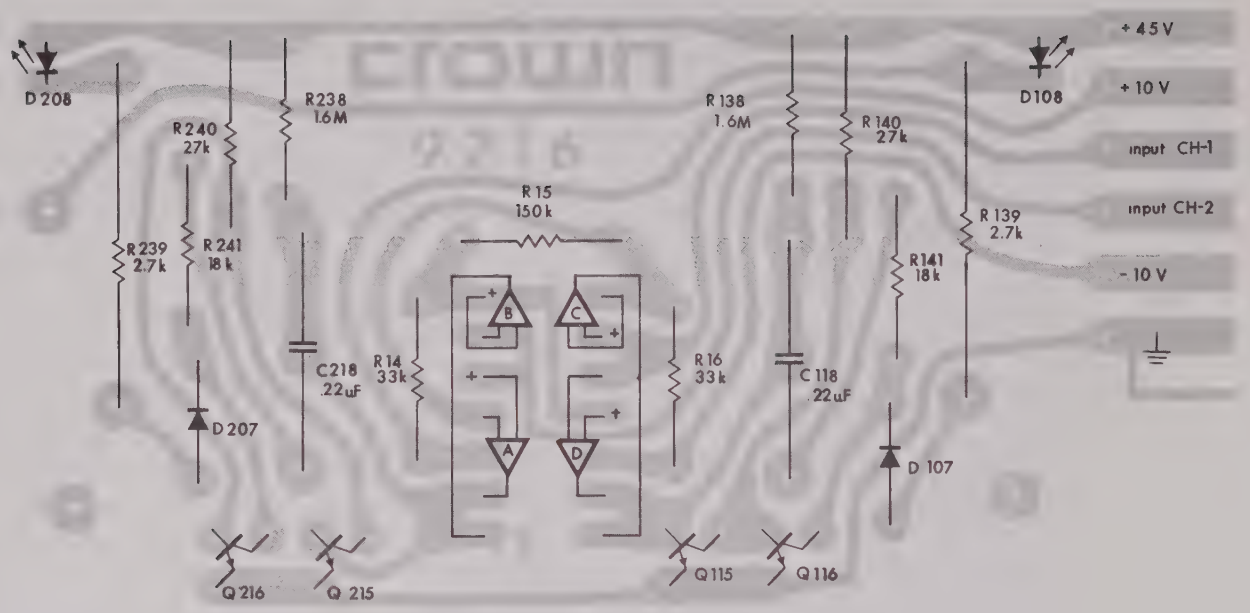
Schematic Designation	Description	Crown Part #	Other Informat.on
	TO-3 insulator	4071	Used to mount outputs.
	6/32 x .625 BHP screw	3879	Used to mount outputs & drivers (all except one mounting hole, see below).
	#6 internal star washer	1823	Used to mount outputs & drivers.
	Solder lug #6 hole	3163	Used to mount outputs & drivers.
	6-32 hex nuts	1889 CAD	Used to mount outputs & drivers.
	Plastic shoulder washers	3335	Used in remaining hole.
	4-40 x ⅝ RHS screw	3334	Used in remaining hole.
	#4 internal star washer	1824	Used in remaining hole.
	Solder lug #4 hole	1220	Used in remaining hole.
	4-40 hex nut	1938	Used in remaining hole.
R132, R232 R134, R234	.1 ohm 5W 10% wire	3291	Mounted on solder lugs on outputs.
R133, R233	2.7 ohm 1W 10% resistor	1001	
C1, C8, C116, C216	.1 MF 200V Filmatic mylar	2938	
C115, C215	.22 MF 100V Filmatic mylar	3218	
	D-150A heatsink fins	3956	
	10-24 x ¾ SWAGE screw	4017	Used to fasten heatsink. Two on end also secures end cover.
	D-150A board cover	9564-S	Mounts over switch - jack plate
	Switch - jack plate hold down cover	9594-S	Mounts over control plate and board cover.
	D-150A Back Label	4020	Mounted on board cover.
	8-32 x ¼ THP screw	2271 CHR	Holds down cover and plate.
	Transformer wraparound	4362	
	Transformer cover	3355	
	10-32 x ½ THP screw	2049 NIC	Used to fasten 3355.
	D-150A front panel	4090	
	D-150A FP Overlay	4091	
	6-32 x ¼ BHP screw	1954 CAD	Used to fasten FP
	5.25 end bar	4092	
	6-32 x ¾ SCP screw	1858	Used to secure 3462.
I1	1822 Lamp	2900	Pilot light.
	Fuse Caution label	4401	Internal fuse label
	Lamp Socket	1262	Mounts on front panel.

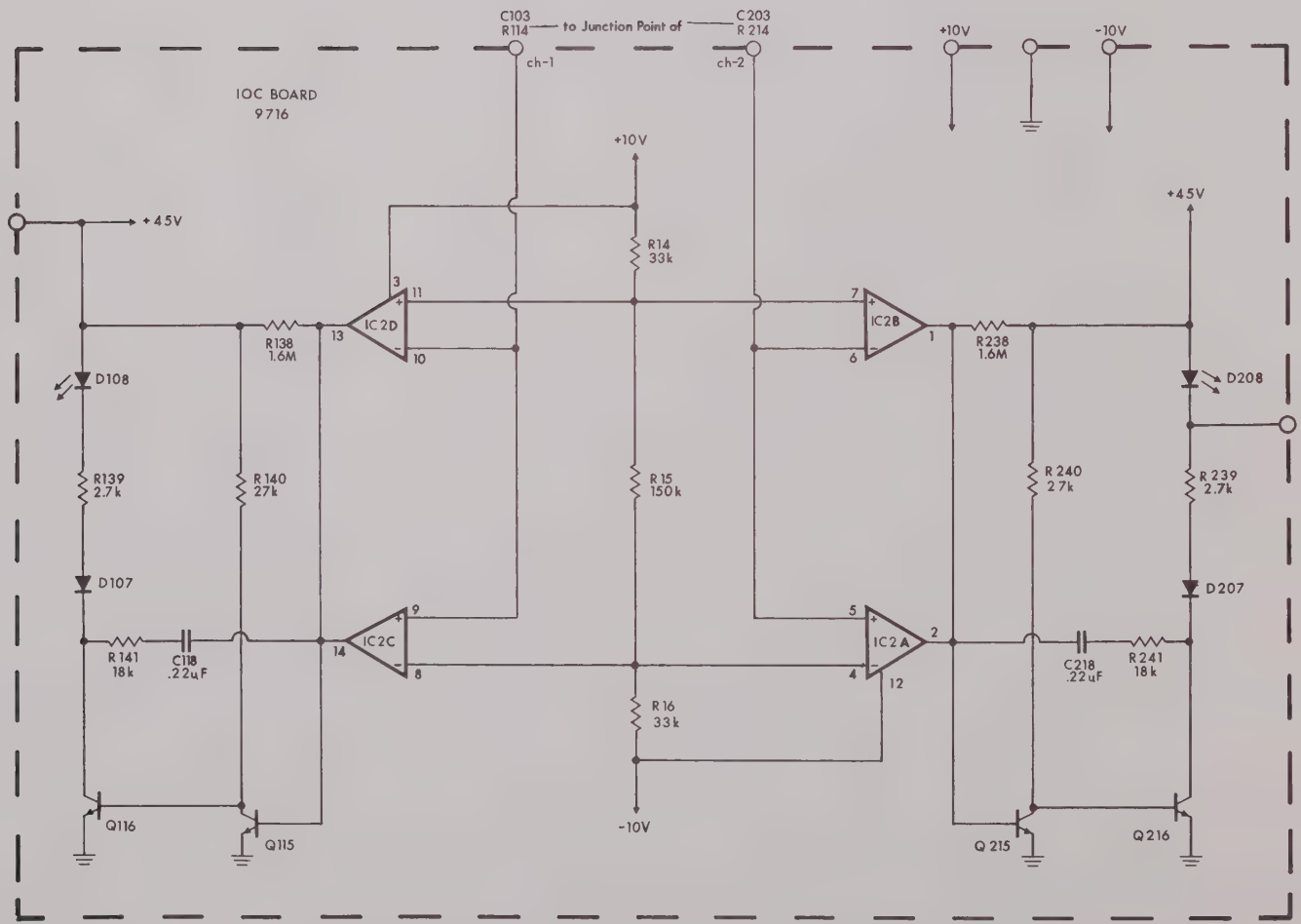
Schematic Designation	Description	Crown Part #	Other Information
	Lamp Bracket	9598	Used to mount socket.
SW2	1P1 Position rotary power switch	3492	
	Power switch cover	4028	Mounts over SW2.
R105, R205	25K audio pot	2942	Input level controls.
	334 solder lug	2828	Used on input level controls.
	⅜" Bright nut	1288	Used to mount pots and SW2.
	⅜" Bright washer	2189	Used to mount pots and SW2.
	⅜" Int. star washer	2188	Used to mount pots and SW2.
	Knob	9641	Used on input level controls and power switch.
	End bars	4092	
	Serial tag	4193	
	ACCESSORIES		
	Hi-Fi Adapter Kit	40377	
	Dual banana plug	2981	
	3AG fuseholder with 1.5A fuse	4245	
	Model 74B wire nut	3069	
	Pin-Phone cable	3339	
	RMB-5 Kit	41628	
	Allen wrench	3454	
	5 x 8 Zip-lip poly bag	3073	
	Rack mount brackets	4093	
	10-32 Panel Thumbscrew - Washer Assy.	20032	

D-150A IOC Module

Parts List

Schematic Designation	Description	CPN	Other Information
	IOC Module		
	Capacitors		
C118, C218	.22 uF 100V filmatic	3218	
	Resistors		
R138, R238	1.6M ohm 1/4 watt 5% CF	4235	
R139, R239	2.7K ohm 1 watt 10% comp	1079	
R140, R240	27K ohm 1/2 watt 5% CF	3970	
R141, R241	18K ohm 1/4 watt 5% CF	2633	
R14, R16	33K ohm 1/4 watt 5% CF	4346	
R15	150K ohm 1/4 watt 5% CF	4216	
	Semiconductors		
Q115, Q215 Q116, Q216	Selected 2N3859A	2961	
D107, D207	1N4148	3181	
D108, D208	MV5053 red LED	4341	
IC2A,B,C,D	LM339N Volt comparator	4345	
	Miscellaneous		
	Overload Indicator PC board	9716	Blank board
	14 pin DIL IC socket	3450	Socket for IC2
	1/2" LED spacer	9722	Used between LED and PC board
	6-32 hex nut	1889	Used to mount board
	#6 internal star lockwasher	1823	Used to mount board
	Spacer	4612	Used between PC board and front panel
	6-32 x 1" hex machine screw	4333	Used to mount PC board to front panel
	7 1/2" tubing	1381	
	Fiber washer	3575	Used to position LED's
	#10 internal star lockwasher	2279	Used to potition LED's


D208
R238 1.6M
R240 27k
R239 2.7k
R241 18k
C218 .22uF
D207
R14 33k
R15 150k
R16 33k
R138 1.6M
R140 27k
C 118 .22uF
R141 18k
D108
R139 2.7k
D 107
Q 216
Q 215
Q 115
Q 116
+ 45 V
+ 10 V
input CH-1
input CH-2
- 10 V


C103 R114
to Junction Point of
C203 R214
ch-1
ch-2
+10V
-10V
IOC BOARD 9716
+45V
R14 33k
IC 2D
IC2B
R138 1.6M
R238 1.6M
D108
D208
R139 2.7k
R140 27k
R15 150k
R240 2.7k
R239 2.7k
D107
D207
IC2C
IC2A
R141 18k
C118 .22uF
C218 .22uF
R241 18k
R16 33k
Q116
Q115
Q 215
Q 216

MASTER WARRANTY & SERVICE STATION: (Parts Depot & Overhaul)

Boho Electronic Labs
286 McLean Place
Hillside, NJ 07205
Phone: (201) 686-4687

WARRANTY SERVICE STATIONS BY STATE:

ALABAMA

Audio Service Company
1900 B 11th Ave. South
Birmingham, AL 35205
Phone: (205) 328-7656

Developmental Systems
729 E. Glenn, P.O. Box 1029
Auburn, AL 36830
Phone: (205) 821-8435

ARIZONA

Godesca/Audio Design
601 E. Blacklidge
Tucson, AZ 85705
Phone: (602) 882-9016

CALIFORNIA

Action Audio Electronics
323 S. Mayfair Ave.
Daly City, CA 94015
Phone: (415) 756-7440

Balbert Electronics
13327 Washington Blvd.
Los Angeles, CA 90066
Phone: (213) 397-3900

California Audio Service
13910 Ventura Blvd.
Sherman Oaks, CA 91423
Phone: (213) 986-7601

California Sound Engineers
475 Barneveld Ave.
San Francisco, CA 94124
Phone: (415) 647-9223

Lewton's Inc.
4255 University Ave.
San Diego, CA 92105
Phone: (714) 284-9258

The Sound Company
1971 Monument Blvd.
Concord, CA 94520
Phone: (415) 825-0299

Teletek Enterprises
11505 Douglas Road, Box B
Rancho Cordova, CA 95670
Phone: (916) 351-0535

Western Radio Labs
2455 J Olde Middlefield Way
Mountain View, CA 94040
Phone: (415) 967-6250

COLORADO

A. B. & K. Service
1459 South Pearl
Denver, CO 80210
Phone: (303) 777-4408

Emrad Sound Clinic
4165 S. Broadway
Englewood, CO 80110
Phone: (303) 789-4153

DELAWARE

Drummond Engineering Service
412 Delaware Ave.
Wilmington, DE 19801
Phone: (302) 571-8284
(302) 571-8295

FLORIDA

Audio-Tronics
6701 Beach Blvd.
Jacksonville, FL 32216
Phone: (904) 724-7335

Audio Workshop
2217 Biscayne Blvd.
Miami, FL 33137
Phone: (305) 576-6022

Electronic Service Labs
724 Virginia Drive
Orlando, FL 32803
Phone: (305) 894-6391

GEORGIA

Norman's Electronics
4014 Peachtree Road NE
Atlanta, GA 30319
Phone: (404) 237-3349

Specialized Audio Services
2055 Piedmont Road
P.O. Box 13806
Atlanta, GA 30324
Phone: (404) 633-3980

ILLINOIS

Balthesar Engineering
186 Glenview
Elmhurst, IL 60126
Phone: (312) 832-3736

IOWA

Kelly Audio Service
5744 "D" Ave. NW
Cedar Rapids, IA 52405
Phone: (319) 396-3706

January 1, 1978

KANSAS

Thomason Electronics Inc.
2810 West 53rd St.
Shawnee Mission, KS 66205
Phone: (913) 722-5000

LOUISIANA

Hi Fi Doctor
4231 Perkins Road
Baton Rouge, LA 70808
Phone: (504) 389-0967

Westbank Audio Service
43 5th St.
Gretna, LA 70053
Phone: (504) 367-1804

MARYLAND

Stereo Clinic
9010 Harford Road
Baltimore, MD 21234
Phone: (301) 882-4994
(301) 838-1010

MASSACHUSETTS

Audio Metrics
Box 182
East Freetown, MA 02717
Phone: (617) 947-7297
(617) 998-3386

Doctor Decibel
401 Worcester Road
Framingham, MA 01701
Phone: (617) 872-5045

Hearing Things
319 Main St.
Worcester, MA 01608
Phone: (617) 757-9658

Stereo Lab
16 Eliot St.
Cambridge, MA 02138
Phone: (617) 864-1144

MICHIGAN

A B L Electronic Service
32 East 14 Mile Road
Madison Heights, MI 48071
Phone: (313) 588-6663

Tape Recorder Specialists
216 East Washington
Audio Service Bldg.
Ann Arbor, MI 48108
Phone: (313) 663-4152

(continued)

MINNESOTA

Sound Equipment Services
321 University Ave. SE
Minneapolis, MN 55414
Phone: (612) 379-1235

MISSOURI

Alpha Audio Labs
1700 S. Big Bend Blvd.
St. Louis, MO 63117
Phone: (314) 645-5250

NEW HAMPSHIRE

E M F
108 R Main St.
Keene, NH 03431
Phone: (603) 352-8400

NEW JERSEY

Boho Electronic Labs
(see Master Warranty above)

NEW MEXICO

Audio Clinic
1616 Eubanks NE
P.O. Box 11009
Albuquerque, NM 87112
Phone: (505) 298-7566

NEW YORK

Acoustatronic Labs
dba Electra-Tech
140-11A Cherry Ave.
Flushing, NY 11355
Phone: (212) 463-1192

Audio Clinic
460 State St.
Rochester, NY 14608
Phone: (716) 232-7057

H.P. Kopp Sales & Service
1650 William St.
Buffalo, NY 14225
Phone: (716) 893-2800

OHIO

Audio & TV Electronics
4419 Brookpark Road
Cleveland, OH 44134
Phone: (216) 351-2025

Canton Audio Service
1416 Whipple Ave. NW
Meyers Lake Plaza
Canton, OH 44708
Phone: (216) 477-5770

Toledo Music Service
3120 Houghton
Toledo, OH 43606
Phone: (419) 475-9700

OREGON

Corvallis Audio Video
401 SW 3rd St.
P.O. Box 1161
Corvallis, OR 97330
Phone: (503) 757-0438

Northwest Audio
15964 SW Boones Ferry #106
Lake Grove, OR 97034
Phone: (503) 635-3574

PENNSYLVANIA

Jones Electronic Service
947 Old York Road
Abington, PA 19001
Phone: (215) 887-1522
(215) 548-7711

SOUTH CAROLINA

Charles-Towne Sound
2213 Middle St.
Sullivan's Island, SC 29482
Phone: (803) 883-3381

TENNESSEE

D B Electronics
112 Northshore Drive
Knoxville, TN 37919
Phone: (615) 588-9532

TEXAS

Audio Masters
2825 Hancock Drive
Austin, TX 78731
Phone: (512) 454-6151

Electronic Shop
2820 Walnut Hill Lane
Dallas, TX 75229
Phone: (214) 350-4003

E T S Labs
5833 Bissonet
Bellaire, TX 77401
Phone: (713) 664-7070

UTAH

Interwest Electronics
4091 South State St.
Salt Lake City, UT 84107
Phone: (801) 266-5301

VIRGINIA

Hurst Electronics
1080 Elden St.
Herndon, VA 22070
Phone: (703) 471-4580

WASHINGTON

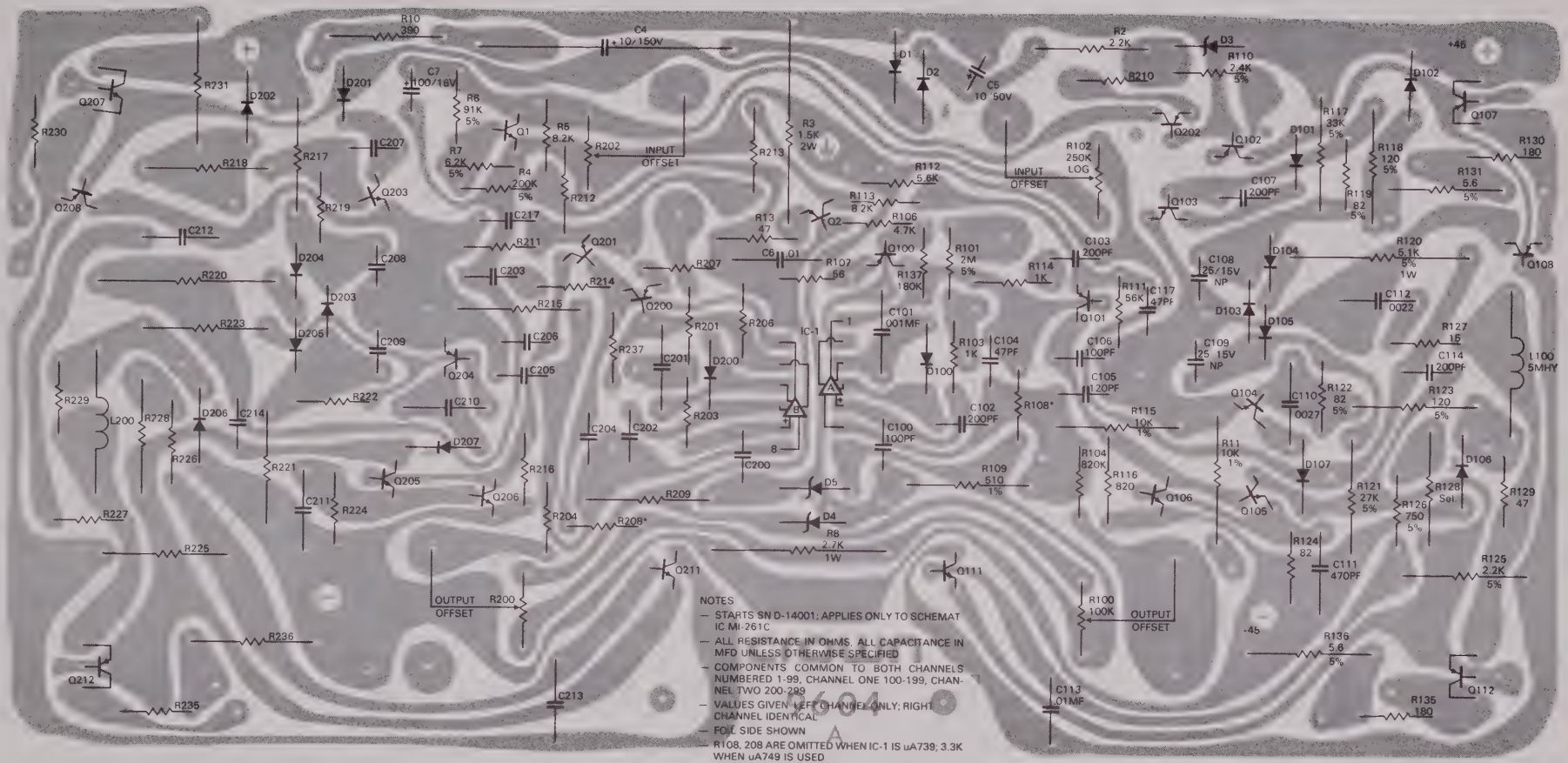
Northwest Audio Service
2318 6th Ave.
Seattle, WA 98121
Phone: (206) 624-0369

WISCONSIN

D & D Electronics
128 North Main St.
Thiensville, WI 53092
Phone: (414) 242-5100

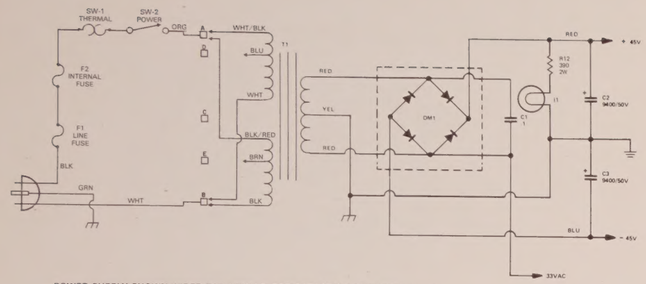
CANADA (Parts Depot)

Remcron Electronics
2250 Midland Ave. (Unit #1)
Scarborough, Ontario
Phone: (416) 291-1691



NOTES

- STARTS SN D-14001; APPLIES ONLY TO SCHEMAT IC MI-261C
- ALL RESISTANCE IN OHMS, ALL CAPACITANCE IN MFD UNLESS OTHERWISE SPECIFIED
- COMPONENTS COMMON TO BOTH CHANNELS NUMBERED 1-99, CHANNEL ONE 100-199, CHANNEL TWO 200-299
- VALUES GIVEN LEFT CHANNEL ONLY; RIGHT CHANNEL IDENTICAL
- FOIL SIDE SHOWN
- R108, 208 ARE OMITTED WHEN IC-1 IS uA739; 3.3K WHEN uA749 IS USED

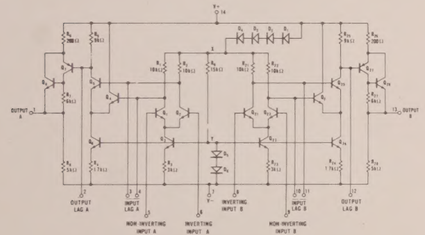


POWER SUPPLY SHOWN WIRED FOR 120VAC. FOR OPERATION AT ANOTHER LINE VOLTAGE FOLLOW CONVERSION CHART BELOW. SELECT THE CORRECT VOLTAGE; CAREFULLY IDENTIFY ALL WIRES BEFORE PROCEEDING.

NOTE: ONLY FOUR TRANSFORMER PRIMARY WIRES ARE USED FOR ANY VOLTAGE CONFIGURATION. THESE WIRES ARE SOLDERED TO AN ADJACENT TERMINAL STRIP (A, B, C). THE REMAINING TWO WIRES (UNUSED) ARE SOLDERED TO AN EXTRA TERMINAL STRIP (D, E).

FOR CONNECTIONS BELOW 200VAC THE LINE FUSE, F1, IS 6.25 AMPS. FOR CONNECTIONS 200VAC AND ABOVE, F1 IS 3 AMPS.

VOLTAGE	A	B	C	D	E
100	BLU, BRN	WHT, BLK	—	WHT/BLK	BLK/RED
120	WHT, BLK, BLK/RED	WHT, BLK	—	BLU	BRN
200	BLU	BLK	WHT, BRN	WHT/BLK	BLK/RED
220	BLU	BLK	WHT, BLK/RED	WHT/BLK	BRN
240	WHT/BLK	BLK	WHT, BLK/RED	BLU	BRN



"IC" Pin Numbers (Top View)

NOTES:

THIS SCHEMATIC APPLIES TO AMPLIFIERS NUMBERED D-14001 AND ABOVE (DOES NOT APPLY TO ANY EARLIER UNITS).

POWER SUPPLY SHOWN STARTS SN 16310.

CIRCUIT SHOWN APPLIES TO PC BOARD #9604 ONLY.

DC VOLTAGES ARE SHOWN FOR VARIOUS POINTS. THESE ARE THE NORMAL OPERATING VOLTAGES FOR ZERO INPUT.

THE HEAVY CONTINUOUS TRACE FOLLOWS THE PRIMARY SIGNAL PATH THROUGH THE CIRCUIT. THE HEAVY BROKEN TRACE SHOWS FEEDBACK PATHS.

WIRE COLOR CODES ARE GIVEN FOR THE MAIN POWER SUPPLY AND SOME BOARD WIRES.

ALL RESISTORS IN OHMS UNLESS OTHERWISE STATED.

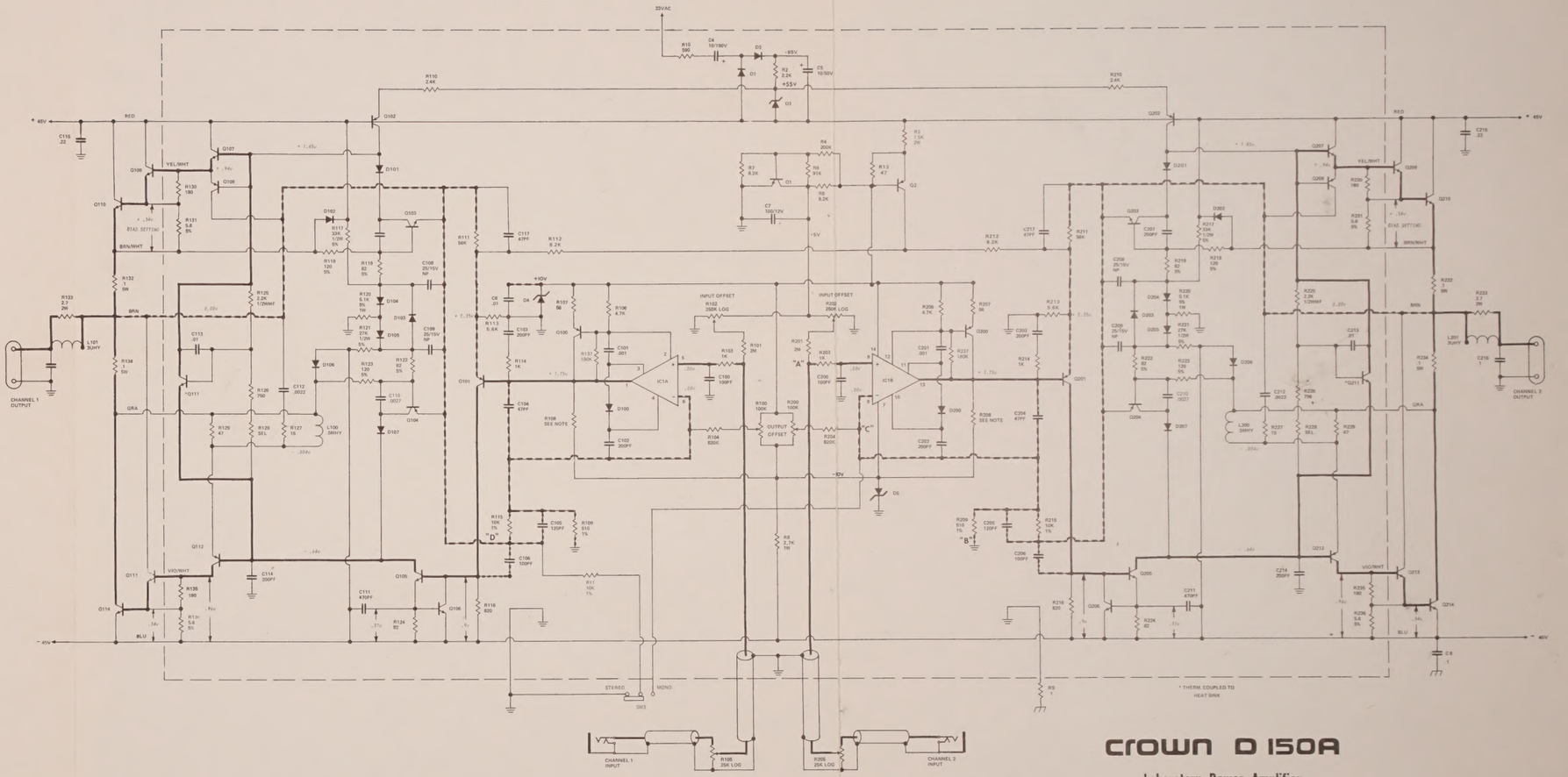
ALL CAPACITORS IN MICRO-FARADS UNLESS OTHERWISE STATED.

COMPONENTS COMMON TO BOTH CHANNELS ARE NUMBERED FROM 1 TO 99.

CHANNEL ONE COMPONENTS ARE NUMBERED FROM 100 TO 199.

CHANNEL TWO COMPONENTS ARE NUMBERED FROM 200 TO 299.

R108, 208 ARE OMITTED WHEN IC-1 IS uA739; 3.3K WHEN uA749 IS USED.



crown D 150A

Laboratory Power Amplifier

MI 261C

PROPERTY OF DEPT. C-270
METROLOGY LAB.
DO NOT REMOVE
FROM AREA

PROPERTY OF DEPT. C-270
METROLOGY LAB.
DO NOT REMOVE
FROM AREA